British

Marine Algæ.

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British Marine Algæ:

BEING A POPULAR ACCOUNT OF

THE SEAWEEDS OF GREAT BRITAIN,

THEIR

COLLECTION AND PRESERVATION.

ILLUSTRATED.

By W. H. GRATTANN.

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British Marine Algae.

INTRODUCTION.

Visitors to the seaside frequently complain of the want of amusement and occupation there. I will endeavour to suggest a source which will supply at once amusement, occupation, and instruction. Most people are fond of flowers, and many there are who know something about them; but how few among them know anything about seaweeds! The object of this book is to call attention to the beauties of marine vegetation, and to help, by means of accurate and characteristic illustrations, to the recognition and appreciation of the many lovely plants which either in thoughtlessness or ignorance people cast aside or tread under foot as they wander on the sea shore.

The vegetable kingdom is classed under two grand sub-divisions, described by botanists under the terms *Phanerogamia*, or flowering plants, and *Cryptogamia*, or flowerless plants. In flowering plants are recognised, in all periods of life beyond the earliest, two distinct kinds of the product of the growth; these are an axis or stem, and leaves and flowers, the latter being succeeded by the perfect development of special organs containing the fruit or seed of the plant. In seaweeds there is no corresponding arrangement of seed-producing organs, the axis or stem only is represented, but never clothed with leaves and floral organs capable of producing seed vessels. The stem assumes a remarkable variety of forms, in some instances simulating those of perfect leaves, but never presenting that distinct separation into leaf and stem, such as we observe in the characteristic structure of flowering plants. The leaf-like and branching expansions of seaweeds perform at once the office of stem, root, and leaf, and represent what in the cryptogamic division of plants is termed "frond."

Seaweeds, like all other plants which belong to this great sub-class, are reproduced by a simple kind of seed called spore, in which (so scientific botanists say) no embryo or rudimentary plant exists at the period when it is thrown off by the parent plant. Thus the term "spore" is now applied to the reproductive bodies of all flowerless plants, while that of "seed" specially belongs to the ovules of all the *Phanerogamia*, or flowering plants. The spores of seaweeds are produced in variously-formed capsules, which in some are borne on the branches, and in others are immersed in

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membranaceous expansions. Their form, situation, and characteristic distinctions, will be fully described in connection with the figures of species which will form the illustrations to these pages.

There is one fact which makes the study of cryptogamic botany peculiarly interesting, and that is that a large portion of fossil vegetation is very intimately related to some of the nobler flowerless plants, and probably exhibits far grander and more highly organised individuals than any which at the present time are found in a living state. The celebrated Hugh Miller informs us that fossilized algæ were not discovered until so recent a period as the year 1856, when some of the fucoids, or kelp-weeds, were detected in some ancient rocks in Shropshire. In the ancient Lower Silurians of Dumfriesshire, these rock weeds were so abundant that they have produced large tracts of anthracite coal several feet in thickness. The string-like plant known as *Chorda filum*, or popularly, "dead mens' lines," had a Lower Silurian representative, known to the palæontologist as *Palæochorda*, or ancient rope. The well-known "Carrageen moss" of the Irish had also a Lower Silurian prototype, and our *Fuci* or rock kelp-weeds were represented by *Fucoides gracilis* of the Lower Silurians of the Malverns; in fact, the Thallogens of the earliest periods of vegetation appear to have resembled in their general characteristics the algæ or sea-weeds of the present era.

Were I to attempt to give a history of the various systematic arrangements by different authors, or of the steps by which we have arrived at our present knowledge of marine vegetation, I should certainly weary the reader; therefore I will state at once, that the plan I shall adopt in these pages is based on the system of the late Professor Harvey, of Dublin, as recently revised by Professor Agardh, the celebrated Swedish algologist. These admirable botanists have distributed the algæ into three large groups, which may be briefly described as follows: First, or simplest in point of structure, *Chlorospermeæ*, mostly grass-green, but varying occasionally to olive, purple, or other tints; *Melanospermeæ*, olive-green, sometimes inclining to yellow or brown-olive; and *Rhodospermeæ*, rose-red, with every variety of pink, red, or brown-red tints, sometimes purple, but very rarely green. These three great sub-divisions are separated into orders, genera, and species. The Chlorosperms consist at present of six orders and twenty-three genera. The Melanosperms of six orders and thirty-five genera, and the Rhodosperms of thirteen orders and sixty-six genera. The name alga, which, as Dr. Harvey says, formerly included the lichens, is now limited to that large group of flowerless plants which constitute the characteristic vegetation of the waters, the marine division of which is now popularly termed seaweeds.

Seaweeds may be characterised as cellular flowerless plants, living in or entirely under water, and deriving nourishment throughout their whole substance from the medium in which they vegetate. Roots, properly so called, they have none; the base of the plant, by which it is attached to the rocks or other substances, serving merely as a holdfast, to prevent the

plant from being driven about and destroyed by the action of the waves; but as no vessels of absorption have hitherto been discovered in the roots and stems, it is evident that seaweeds do not derive their nourishment from the substance to which they are attached, for indeed they are found growing luxuriantly alike on iron and floating timber, on rocks and shells, on the carapaces of crabs, and even upon each other, in the latter case without any detriment whatever to the species on which they are parasitic. The roots or holdfasts in some are a flattened or slightly conical disc, in others branching and clinging fibres, and in the *Laminariæ* or oarweeds, especially as the plants advance in growth, a series of grasping processes are thrown down from the stem, which adhere so firmly to the rock that it is extremely difficult to detach them.

The algæ, or seaweeds, consist entirely of cellular tissue—little membranous sacs or cells of various forms, with walls of different degrees of tenacity. These minute cells are empty or filled with granular organised matter, which divides and developes new cells; these again divide and produce others, and thus by this cell splitting, branches and spreading fronds or leafy expansions are produced, each order of cell-division proceeding according to the laws of growth of its own species. The cellular tissue of which all seaweeds are composed presents several varieties. The most common form of cell is that of a cylinder, generally much longer in proportion to its breadth, and when such is the case the cells are attached end to end, forming threads or filaments, numbers of which, branched or otherwise, make up the frond by becoming firmly attached in bundles. Many of the simpler kinds of seaweeds are made up of threads or strings of cells, some of which are elaborately branched, others unbranched, yet throughout the whole plant the cells or joints are invariably produced in the unbranched kinds from the tips of the cells of those beneath them, or from the upper side, as well as from the tips of the joints in the branching species. A portion of a filament of *Conferva tortuosa* (Fig. 1) and a branchlet of *Cladophora Hutchinsiæ* (Fig. 2) will illustrate the simple cellular or jointed structure of branched and unbranched filaments. Polygonal and other forms of cells are found in the leafy and membranous species, the particular forms being in most cases due to cell-pressure during growth, some adhering very closely together, and accommodating their forms to the spaces they have to fill, while in others the cells are set, as it were, within a transparent gelatine, each cell being completely sepa-

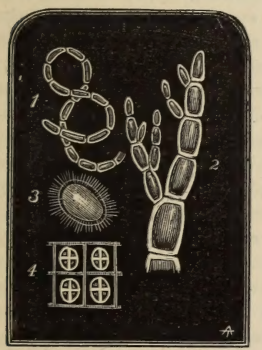


FIG. 1. *Filament of Conferva tortuosa.*
FIG. 2. *Cladophora Hutchinsiæ.*
FIG. 3. *Spore clothed with cilia (white or coloured).*
FIG. 4. *Sporules from Porphyra laciniata.*

rated from its neighbour by a hyaline or colourless space or border. The contents of the cells which give to the plants their various hues are termed endochrome or chlorophyll, and it is from this colouring matter in connection with a partial metamorphosis of certain portions of some species that the fructification of seaweeds is produced. Of the various forms of fructification and other particulars connected with the different systems of reproduction I shall speak as occasion arises. Thus much, however, I may state at once, that in speaking of the reproductive bodies of some of the green plants, the term "zoospore," in addition to that of spore, will be occasionally used, the word zoospore signifying animal seed, from the peculiar movements it exhibits in the water by means of the filaments with which it is furnished.

When examined by the microscope, the spores of most of the seaweeds at the time of their emission from the cells of the parent plant are found to be clothed with very minute hairs, the constant vibratile motion of which causes them to move about with the greatest activity. "The little spore," says Professor Harvey, "whilst contained within the mother cell, commences life by knocking continually against the walls of the inclosure until it has burst through them into the surrounding water, and then with many gyrations and rapid changes of place it swims about by means of the cilia with which it is clothed, until it finds a substance on which it can rest and attach itself. Once fixed, or apparently satisfied with its locality, its youthful wanderings are over, and its seemingly voluntary motions cease. The cilia are absorbed or perish, and the vegetable cellule commences the growth natural to its kind, and finally becomes a plant resembling the species from which it sprang." A spore is represented, of course very highly magnified, by the little oval figure (Fig. 3) in the group of diagrams.

Among the various uses of seaweeds in the economy of nature, especially among the green plants, is that of the power they possess, although in a small degree, of contributing to the purification of the water in which they live. This is due to the oxygen which is generated in their delicate tissues, from the carbonic acid which they absorb from the surrounding water. Few marine animals will live long healthily in the confinement of aquaria, unless the water be properly supplied with growing plants of *Ulva* and other green seaweeds.

In an interesting little work on British Seaweeds, by the late Dr. Lansborough, I remember reading an account of a rebuff given to an enthusiastic young student by a professor of botany, to whom he had shown the contents of his vasculum, after a day's gathering on the sea shore. "Pooh, pooh, sir," said the old gentleman, "a parcel of seaweeds—pah." Nice encouragement this must have been for a botanic student, perhaps an incipient algologist! This reminds one of the "*Alga projecta vilior*" of the old Roman poet—terms of contempt for the beauties of the deep, which, I suppose, must be forgiven, in consideration for the glorious verses which the speaker has bequeathed to us. However, as regards the old professor

of botany, it is very probable that the extent of his acquaintance with sea-weeds was limited to the *rejectamenta* of the sea; for the rebuff referred to took place some sixty or seventy years ago, at which period a knowledge of seaweeds was very scanty indeed; numbers of species which are now familiar to every collector had not then been discovered, the dredge was hardly in use, and the microscope was in its infancy. Things, however, are very different now, and there is really no excuse for people who may desire some acquaintance with marine algæ, talking of the difficulty of finding beautiful plants, of learning their names, and of mounting and arranging them. I have very often been appealed to for information as to the best method of acquiring knowledge on this subject, and my invariable advice has been, as I write it once more, read some standard work on sea-weeds in the first place, study the figures of the plants, for indeed good illustrations are indispensable to a perfect comprehension of the best descriptions of species, and then go and gather the flowers or weeds of the ocean, call them what you will, and he or she must be a churl indeed who is not quickly fascinated with such an occupation, which not only brings health unsought, but elevates the mind, and thus by pointing through nature up to Nature's God, enlarges man's ideas of the wisdom, power, and goodness of the Creator.

I have often been amused to see the strange, not to say absurd, mistakes made by beginners in naming their plants; and I doubt not many a botanist as well as myself has been provoked at the disinclination so frequently evinced by amateur collectors to anything approaching study by means of the microscope, as though it were possible to acquire knowledge in botanical pursuits without its help, or at least that of a good lens or magnifier. Look, for instance, at the *Cladophora*, to a few of which I shall call the reader's attention by means of my figures of magnified branchlets. True, an experienced algologist knows at once what is the species he has before him, but he did not *always* know it, and, although the eye soon learns to detect differences in appearance, knowledge of specific distinctions among the filamentous and delicately-branched seaweeds can only be acquired by means of the microscope.

SECTION I.

CHLOROSPERMEÆ.

Green Seaweeds.

Among the most abundant of the common species of seaweeds are two, *Ulva latissima* and *Porphyra laciniata*, which form together, when prepared and potted, the laver of commerce; the latter, although belonging to the chlorosperms, in accordance with its system of fructification, is brown, or sometimes a lurid purple. There are several tolerably well-defined species of each of these plants, some of which are found abundantly on rocky shores, while others are somewhat rare. The species most commonly met with is *Ulva latissima* (Fig. 5), or the very broad Ulva, or

Fig. 5. *Ulva latissima.*

Fig. 6. *Ulva linza.*

amiliarly, lettuce weed or green laver. This species is found on all shores and in all latitudes, except in the Arctic regions, though even there a small stunted species called *Ulva crispa* is sometimes met with. The frond of *Ulva latissima* is delicately membranaceous and of a bright green colour; in form it is usually a broad, rounded oblong, from 6in. to 14in. long, often very much waved at the margin, and attached to the rocks by a very minute disc. The spores are usually arranged in groups of fours, and are scattered over the whole frond.

Ulva linza (Fig. 6), a beautiful and very graceful species, though by no means rare, is not so abundant as the former plant. It grows in similar situations, and sometimes even in society with it. The plant consists of a cluster of fronds from 6in. to 2ft. in length, about 1½in. in width, and tapering gradually to the base. The fronds are generally very much curled and waved at the margin, and the whole plant is of a bright grass-green colour. The frond of this species consists of two delicate membranes, the cells of which are divided vertically and horizontally, so that they are at once leaf-like and tubular. To ordinary observers, this plant bears a strong resemblance to *Enteromorpha intestinalis*; and, indeed, Dr. Greville, of Edinburgh, in describing this species, points out the fact of its double membrane, forming at least a transition to the genus *Enteromorpha*. Collectors, however, after a very little practice in comparing specimens of these plants, will not have much difficulty in distinguishing them; *Enteromorpha intestinalis* being always tubular and somewhat constricted at intervals, while *Ulva linza* is comparatively flattened, never constricted, and always more or less waved at the margin. *Porphyra laciniata* bears a striking resemblance to *Ulva latissima*, not only in outward form, but in its fructification, which consists of sori or groups of spores. Under the microscope the whole membrane of the plant appears to be divided into segments or square groups of cells, regularly arranged in fours, and within these squares are contained four purple spores, as seen in the illustration (Fig. 4). *Porphyra*, under the name of laver, is boiled and eaten with lemon juice or vinegar, and is not only very wholesome, but agreeable in flavour, and were it not for the ignorance and prejudice which sailors exhibit concerning things they know not, this common seaweed might become a valuable article of vegetable diet to the crews of whaling vessels and voyagers in the Artic regions, since nearly every marine rock is clothed with its dark brown fronds. The plant in our illustration (Fig. 7) is *Porphyra vulgaris*, a much more elegant species, being narrower, much longer, and very gracefully waved and curled at the margin, somewhat like *Ulva linza*. The colour of *Porphyra* is a very singular departure from the ordinary green tint of the Chlorosperms; the plants of this genus being, in the living state, of a dark brown, which after drying and mounting on paper changes gradually to a fine purple, or sometimes to a rose red.

The order *Ulvaceæ* contains a genus of interesting plants which at present must be merely glanced at, for in the first place they are, with the exception of one species, nearly microscopic, and, secondly, anything like a description of them will necessitate illustrations, most of which would be too minute for the purpose I have in hand, viz., popular information. I will merely state, then, that the genus to which I refer is named *Bangia*, in honour of Hoffman Bang, a Danish botanist. All the species of *Bangia* are purple, or sometimes inclined to brown-red, and they are mostly parasitic on other algæ; one species, and that the largest, being found near high-water mark, growing on rocks and wood. Its name is *Bangia fusca-purpurea*. Inexperienced collectors would hardly imagine this plant

to be included in the Chlorosperms or green seaweeds; and this is another instance of the necessity, as already pointed out by me, of some little book-learning at first, otherwise many a pretty plant will be passed by unheeded or overlooked. The species in question consists of a bundle of purple silky filaments, several inches long, unbranched and very narrow throughout their whole length. The broadest filaments of this delicate plant, under the microscope, are seen to be tubular, and to contain four or five rows of granular cells, a form of structure which connects these plants with the *Ulvaceæ*, otherwise to the ordinary observer, they would appear to belong to the *Confervæ*, a genus of green unbranched plants which I will describe presently.

The *Enteromorphæ*, of which two common species make their appearance about high-water mark clothing rocks and stones with a slippery vesture of shining green, have been the cause of many a tumble to the unwary pedestrian on the sea shore. I have heard these pretty green plants sometimes called "sea-grass" and "mermaids' hair," and, indeed, some of the rarer and finer species may well be termed mermaids' hair or sea hair. But first I must describe the two species that are met with everywhere, and these are *Enteromorpha intestinalis* and *E. compressa*. The former grows in tufts, and is simple, or unbranched; each frond is tubular, and somewhat constricted here and there, and in form resembles the intestine of an animal, hence its specific name; but *E. compressa* (Fig. 8) is a branched species, and is compressed or flattened at the margin. These plants are very variable in length and width, the filaments of some specimens being very narrow, while others are as broad as *Ulva linza*, and very dark in colour. The largest specimens of *Enteromorpha* always appear to me to owe their unusual size to the action of fresh water; I have often seen specimens of *E. intestinalis*, as well as *Ulva latissima*, growing in streams which were scarcely even brackish, more than 2ft. in length, and of such breadth that they appeared like large green bags floating in the water. The structure of the *Enteromorphæ* is very similar to that of *Ulva;* the whole frond is beautifully reticulated, the cells being arranged in fours, or multiples of that number, the endochrome or colouring matter of which at maturity is converted into spores. The fronds of these green plants are often found partially white, and sometimes wholly so. This is due not only to incipient decay, but because the spores have broken away from the cells, leaving the membrane of the plant colourless and unsightly. Then is the time to look for certain rare microscopic parasites, some of which have their special habitat on decaying fronds of *Enteromorpha*, as well as on those of the *Ulvæ*. In addition to these two well-marked and easily recognised species, there are several others, more or less rare. Among these, the most interesting probably is the species called *E. clathrata* (Fig. 9). It grows abundantly in the rock pools all about Torbay, but being a summer annual, it loses much of its bright green colour towards the end of September, and soon after turns to a brownish yellow. In all stages of its growth the fronds are extremely slender, very much

FIG. 7. *Porphyra vulgaris.*

FIG. 9A. *Enteromorpha Linkiana.*

FIG. 8. *Enteromorpha compressa.*

FIG. 9. *Enteromorpha clathrata.*

Conferva Youngana.
FIG. 10. Cells with binate sporangium.
FIG. 11. Portions of filaments.

branched, and set throughout with short, spreading, or recurved ramuli or branchlets.

There are several species of *Enteromorpha*, which, to ordinary observers, so strongly resemble each other that reference to the microscope is absolutely necessary to distinguish them. At the head of these stands *Enteromorpha clathrata*, just mentioned; the others are now classed as varieties of this species, but, although I intend to figure only one of them, chiefly on account of the grace and beauty of the specimen I possess (which is also highly characteristic of the species), I will endeavour to point out certain peculiarities of growth in each of them, so that they will be more readily recognised by inexperienced collectors. I therefore direct the reader's attention to the figure of *E. Linkiana* (Fig. 9A). The frond is about 6in. or 8in. in height, with a distinct main stem, throwing out along its whole length branches several inches long, smaller in diameter than the main stem, and bearing in their turn a second and third series of very fine hair-like branches or filaments, all of which spread out, but incline upwards. *E. erecta* has also a distinct main stem, but the branches, which are set on each side of the stem, are more regular in length and are clothed with finely attenuated ramuli, which taper to a needle-like point. In *E. ramulosa*, the main stem is less definite than that of the two former species, the fronds are tufted and the branches, which are numerous, but of irregular length, are bent, or somewhat curved, in various directions; the ramuli are short and bristle-like, and are set without order on the branches from the base to the tip. The fronds of all these species are all more or less reticulated like a tessellated pavement, and within the cells of the surface the spores are formed, generally in groups of fours. *E. cornucopiæ* is a singular species (if, indeed, it really be a species), usually found on *Corallina officinalis* and other algæ. In early growth the fronds are like little elongated bags, which soon break at the apices and expand into the form which has suggested their fanciful specific name; some botanists regard this plant as merely a form of *Ulva lactuca*, which, in the young state of that species, it certainly very strongly resembles. Other smaller and rarer species of *Enteromorpha* are known under the names of distinguished botanists, and these are *E. Ralfsii* and *E. Hopkirkii*. There is also one other variety of *E. clathrata* known as *E. percursa*.

E. Linkiana, *E. ramulosa*, *E. erecta*, and *E. percursa* were formerly regarded as distinct species, but are now considered as variations of *E. clathrata*. The differences in character are hardly appreciable to any but practised botanists, hence a particular description of all of them is scarcely necessary, at least in a popular account of British seaweeds.

The genus *Conferva* formerly included a large number of green plants branched and unbranched, but it is now confined exclusively to a definite number of filamentous algæ, which are made up of masses, more or less tufted or matted together, of strings of cells or joints, which increase in length, either by a species of budding from the terminal cells of the filaments, or from a continual division of the old cells in the centre. The latter

mode of growth is most general among the *Confervæ* proper, which are all unbranched. Recourse to the microscope is necessary for an examination of their structure, and also to identify species. These simple plants are propagated by zoospores, which are formed from the granular contents of the cells, or from the whole mass of endochrome or colouring matter of one or more cells being concentrated into an enlarged cell and forming there a sporangium or spore-bearing conceptacle, from which, on the perishing of the old plant, new individuals are propagated. Fig. 10 represents a portion of a filament, highly magnified, of *Conferva Youngana*, the central joint of which contains a binate sporangium. Fig. 11 represents portions of two filaments of the same species, highly magnified. Most of the *Confervæ* inhabit fresh water, and are found abundantly wherever stagnant water lies, the oxygen which they continually throw off into the air, helping to neutralize the noxious effects which would otherwise arise from decaying vegetation in the water beneath them. The marine species of *Conferva* are not now very numerous; one of the most common perhaps is *Conferva tortuosa*, well represented in the illustration (Fig. 12), a magnified filament of which was engraved on p. 5 (Fig. 1). This species is mostly parasitic on old stems of the *Fuci*, near high water mark; but the masses of its entangled tortuous filaments are so inextricably interwoven, that it is useless attempting to separate them. The name *Conferva* is from the Latin *Conferruminare*, to consolidate, the ancients having made use of masses of these plants in binding up wounds and fractured limbs.

FIG. 12. *Conferva tortuosa.*

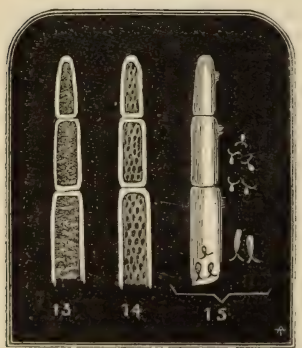
Among the *Confervæ* there are two species by no means uncommon, which at a cursory glance strongly resemble each other, especially when they are seen growing in the water. One of them, *Conferva ærea*, is found on sand-covered rocks about half-tide level, growing in a tuft of erect filaments from 3in. to 4in. in length. The articulations or joints of the filaments are about as long as broad, and the whole plant, though harsh to the touch, loses its rigidity, and lies prostrate as the tide recedes from it. A plant of *Conferva ærea* is shown in (*a*) Fig. 12A, and beside it a fragment of a filament magnified to show the form of the cells. The other species (*b*) is *Conferva melagonium*. It is usually found in rocky tide pools, where its long bristle-like filaments, from 4in. to 12in. in height, stand erect, stiff, and straight, even when left uncovered by the ebb of the

tide. All the articulations, except the lowest, are about twice as long as broad, the endochrome or cell contents being of a dark green colour. A plant of this species is represented at *b*, and beside it, three joints from the centre of a filament. The long filaments of this species are generally few in number, and are set some little distance apart, while those of *C. ærea* are more numerous, and grow in tufts closely packed together. I have described these two plants under the names by which they have been long known, but I must inform my readers that their *generic* name now is *Chætomorpha*, which is at once significant and characteristic, as having reference to their bristle or hair-like appearance. Of course a good lens is indispensable in examining these minutely-jointed plants, otherwise specific distinctions cannot possibly be understood and appreciated. For ordinary purposes a watchmaker's eye-glass is sufficient, but to those who will take the trouble to acquire its use, a Stanhope lens is the algologist's true *vade mecum*.

FIG. 12A. (*a*) *Conferva ærea*, and portion of filament magnified; (*b*) *Conferva melagonium*, and three cells magnified.

I now come to the puzzling but beautiful sub-genus, *Cladophora*, or branch-bearers. All the plants belonging to this family are branched, some most elaborately so; several species are very rigid and exceedingly difficult to display on paper, becoming often so entangled and interwoven as to tire the patience of the most expert manipulator. They are propagated by a conversion of the granular contents of the joints or cells into zoospores, which, upon being cast loose from the cells of the plant, swim about like so many tiny *animalculæ*. The process of development in the zoospores or reproductive bodies of the *Cladophora* is so exceedingly interesting, that I direct the reader's attention to the group of figures (13, 14, 15), which represent the different stages of development in the endochrome or cell contents of *Cladophora lætevirens*. Fig. 13 represents a highly magnified portion of a filament at the moment that the terminal joint has formed a kind of wall or line of division, this being the first step in the process of cell division, and which results in the separation of the endochrome into two portions. Beside it (Fig. 14) is a filament with the cells and zoospores fully developed. On the upper and right wall of each cell is a slight projection, or expansion of the cell

wall, which soon yields to the pressure from within, is finally ruptured, and through these minute orifices the zoospores make their way into the water. The ruptured filament on the right (Fig. 15) is empty; three zoospores only are seen in the lower joint, five ciliated zoospores represent the active state of these bodies, and the two below represent the quiescent stage before germination. The ramification or mode of growth in the *Cladophora*, may be studied from an examination of the branch of *Cladophora Hutchinsiæ*, p. 5 (Fig. 2). *C. lætevirens* (*d*, Fig. 21) or the pale green *Cladophora* is one of the most common species of *Cladophora* met with on rocky shores. It grows in densely tufted masses very profusely branched, and beset on all sides with lesser branches and branchlets. The species in the illustration (Fig. 16) is *C. diffusa*, a loosely branched plant, rather rare, and the easiest to represent accurately in a drawing of any of these delicate algæ. Terminal branchlets of two other rare species are represented in Figs. 17 and 18, *C. rectangularis* and *C. falcata*; the former being easily recognised owing to its branchlets and ramuli, all being set at right angles throughout the whole plant; the latter having branches shaped like sickles, the branchlets being curved in the same direction as their primaries and mostly on the inner or curved side. There are several other pretty species of this family, and among those which are parasitic on other algæ may be mentioned the little cotton-like species known as *C. lanosa*, which grows near the forked tips of a dark-red plant called *Polyides rotundus*. I once found this tiny species in a beautiful



FIGS. 13, 14, 15. *Cladophora lætevirens*. Stages of development in the endochrome.

FIG. 16. *Cladophora diffusa*.

rock pool at Whitsand Bay, near Plymouth, growing on *Polyides* in such profusion that the floor of the pool seemed as though it were carpeted with the most exquisite green velvet. Among the many species of *Cladophora* which I am tempted to describe, there is one which I may mention, though briefly, because it is met with very frequently about half-tide level, growing in rock pools and under the shade of the larger algæ. Its name is

C. rupestris (*b*, Fig. 21) or the Rock cladophora. It is easily recognised by its very dark or blackish-green colour, and by the excessive rigidity of its filaments, and erect ramuli or branchlets. This species does not readily adhere to paper. Therefore, the best way in preparing it for the herbarium is to mount it on paper in the usual manner in sea water, and after it is partially pressed and nearly dry, to immerse it, paper and all, in skimmed milk, and then dry and press it as before, after which it will adhere closely to the paper for an indefinite period.

Fig. 17. *Cladophora rectangularia.*
Fig. 18. *Cladophora falcata.*
Fig. 19. *Vaucheria velutina* (ramuli with vesicles).

To general observers, many of the *Cladophora* look wonderfully alike, all of them being more or less bushy and excessively branched, and green of various shades being the prevailing colour; but as the tints vary greatly, according to the age of the plants and the situation in which they grow, even in individuals of the same species, colour is by no means a character which can be implicitly relied on. An examination of at least terminal branchlets with a good lens is absolutely necessary, and thus they will all be found to be more or less abundantly different. I have selected a few species, which are most likely to be met with, in illustration of my remarks, and because I think that my figures of magnified branches will help students to distinguish their characteristic ramification or mode of growth, and the peculiarity of branching, as well as the differences in the form and size of the articulations in the terminal ramuli or branchlets. The illustration of the species *Cladophora arcta* (Fig. 20, and *c*, Fig. 21) is not only highly characteristic of this plant, which invariably presents a

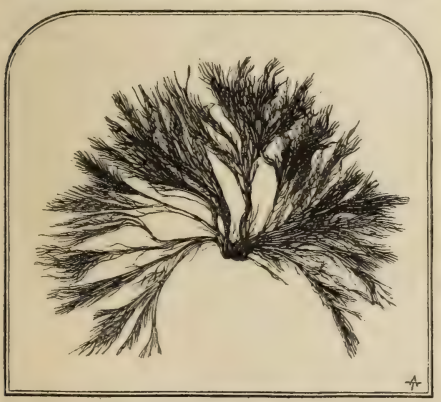


Fig. 20. *Cladophora arcta.*

beautifully arched outline, but it serves to convey a very good general idea of the appearance of growing plants of this genus.

Let me now direct the reader's attention to the group of drawings, Fig. 21. Letter *a* is the terminal sprig of *Cladophora pellucida*. I describe this plant as among the *Cladophora*, though, I regret to say, it has been removed from that genus, and it is now, I believe, the only British representative of the genus *Leptocystea*. It is most easily recognised, not only by its perfect regularity of branching, but by there being only one long cell or joint between each furcation or forking of the branches. Almost all the branches are set at rather acute angles exactly opposite to each other on the sides of the stems, and the terminal ramuli are single jointed, much shorter than the other articulations of the plant, and three in number. All the branches of this species are stiff and wiry, and the dark green endochrome in the joints is surrounded by a pellucid or colourless border. Letter *b*, is a lateral branchlet of *C. rupestris*. In all states of this plant the colour is a very dull dark green, and the branches and ramuli are stiff and harsh to the touch; the ramification is very regular, and, once having had its characters pointed out, the student will have no difficulty in recognising the species. Letter *c* embraces two filaments, one is a terminal branchlet of the pretty species *C. arcta*, in which the joints are about thrice as long as broad, the other represents a portion of the lower parts of the plant in which the articulations are pretty nearly of equal dimensions. This is a favourite species with collectors, as it adheres very well to paper, and preserves its fine glossy green in drying. Letter *d* is a terminal branchlet of *C. lætevirens*. In this species the articulations are of very great length in proportion to their breadth. In early growth the plant is a fine bright green, which becomes gradually paler as it advances towards maturity. This is one of the commoner forms of marine *Cladophora*, and is identical with the fresh-water species, *Cladophora glomerata*. Letter *e* is a terminal sprig of *C. refracta*, one of the most bushy and densely branched of the genus. The young student may study this drawing for some time ere he will carry in his memory the variety displayed in this one terminal sprig of *C. refracta*. If, however, he chance to find this species, he may easily identify it by a comparison with my figure, which, like all the others, has been drawn from the living plant as accurately as possible. There are several other species of this beautiful tribe of seaweeds, some of which are minute and others rare; among the latter is the fine species *Cladophora Rudolphiana*, a specimen of which I possess, but I have never found this species on the English shores. It occurs only, I believe, in Roundstone Bay, and in one or two other stations on the coast of Ireland. *C. gracilis* is one of the most delicate and beautiful of the genus. *C. fracta* is an exceedingly bushy plant. *C. albida* is a fine species, but turns to a pale whitish green in drying, whence its specific name. *C. flexuosa* is a pretty species with wide-spreading branches. *C. Balliana* is a tolerably well-marked species. *C. uncialis*, as its name implies, is about an inch in height and grows on

rocks, while *C. lanosa*, of a similar size, is usually parasitic on other algæ, as already described. *C. glaucescens* is a beautiful species, occasionally reflecting glaucous tints, as referred to in its specific name. *C. Gattyæ*, *Macallana*, *Brownii*, and two or three others, complete the list of British species of this genus.

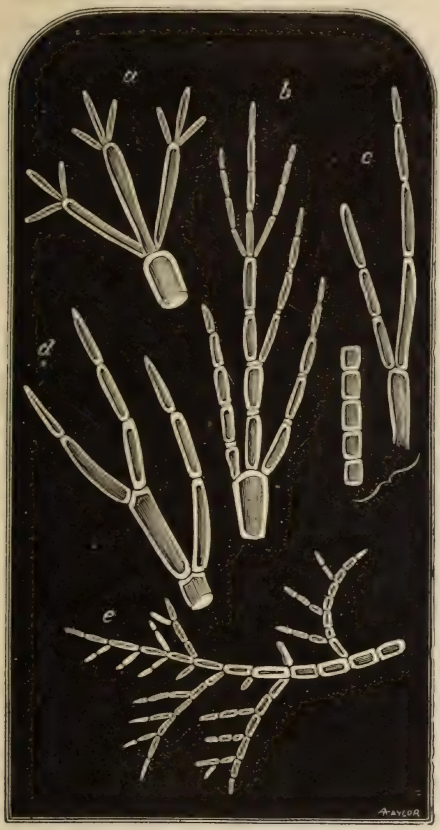


Fig. 21. Branchlets of *Cladophora*.

The curious genus *Codium* contains some very remarkable species, two of which, except that they grow generally in masses on the surface of rocks, rarely attract the attention of ordinary collectors, and are certainly not common; but there is one species which is among the most singular of seaweeds, and that is *Codium bursa*, the Purse-like Codium. This plant is very rare; but, as collectors may unexpectedly meet with it, some little description of the curiosity may not be amiss. Its habitat or place of growth is on rocks, near low water mark, and its appearance is that of a round hollow spongy ball, from one to several inches in diameter. The whole plant is made up of a very closely interwoven mass of tubular filaments, giving to the plant the appearance of a round green sponge. Many years ago I used to find this very rare and curious species growing on one rock only, at the very verge of low water between Brighton and Rotting Dene, and but that the little "mermaid's balloons," as I once heard them called, were green, one might liken them to the well-known puff-balls of the field. The species most commonly met with is *C. tomentosum* (Fig. 22). This plant is also singularly like one of the branching sponges. The stem

and branches are soft and pliable, and are invested with a sort of slimy gelatine very similar to the viscid animal coating of living sponges. Indeed, it is owing to this peculiar feel of the frond that the genus was named from the Greek, κώδιον, or skin of an animal. The illustration shows the mode of growth in a frond of *C. tomentosum*. The branches are generally divided in a dichotomous manner; in other words, regularly forked up to the tips of the divisions, and sometimes the branches throw out here and there short lateral ramuli or branchlets. The structure of this plant is entirely filamentous, the centre being composed of long string-like colourless filaments or fibres, while those which radiate horizontally around them are club-shaped, of a dark green colour, and invested with a thin layer of colourless slime. Dark green vesicles containing the fruit of the plant are borne on the sides of the club-shaped filaments. In mounting this species on paper, care must be observed that heavy pressure be avoided

FIG. 22. *Codium tomentosum.*

FIG. 23. *Vaucheria clavata.*

until the water is all drained out of the frond, otherwise it will adhere to the linen covering, or break off in pieces, and the specimen will be destroyed.

The genus *Vaucheria*, named in honour of M. Vaucher, a distinguished French botanist, contains a few very interesting but minute green plants, and were it not for the dense masses in which most of the species grow, they would be constantly overlooked or disregarded. Some of them are parasitic on other larger algæ, but they are more generally found on the muddy sea-shore, or on mud-covered rocks flooded by the tide. The species named *Vaucheria velutina*, is a summer annual, and consists of a dense mass of branching filaments, colourless below, but above, of a fine green, and of a delicate velvety texture. The branches, which are most intricately interwoven, throw up their little green tips an inch or so above the surface of the mud in which they grow. The fructification consists of a dark-green mass of endochrome contained within a little stalked round vesicle, which sprouts from the side of the erect branches, a short distance below the tips. This is well seen in the

group of magnified filaments at Fig. 19. In the species *V. clavata*, which is frequently found in fresh water, growing in little cushion-like tufts, the fruit is formed and perfected in the tips of the filaments, where the dark-green granular matter is consolidated, and becomes separated from the lower portion by a diaphragm or colourless space. This separated mass, which is somewhat bent in at the centre, forces its way through the tip of the filament, and moves about by means of vibratile cilia, until it has fixed itself, when, by lengthening at each end, it gradually assumes the characteristic form of its species, and thus a new individual is produced. Fig. 23 represents the little club-shaped tip of a filament, the reproductive body forcing its way through the cell wall. The stems and branches of all these pretty little green plants are entirely devoid of joints or partitions, being tubular from the base to the tip of the branches—hence the term *Siphonaceæ*, the name of the order to which they belong.

The most attractive species among the *Siphonaceæ* is unquestionably *Bryopsis plumosa*, very well represented in the illustration (Fig. 24), from a plant taken at St. Leonard's several years ago. The fronds of this pretty green plant arise several from the same base. The plumose or feathered portion is generally confined to the upper half of the fronds, and always terminates them. Occasionally in very luxuriant specimens, the fronds are feathered very nearly to the base, and throw out lateral branches which are beset again with numerous little plumes, until the whole plant presents the appearance of a bunch of delicate green feathers. Every frond of this species is a continuous tube containing a dark green very minutely granular matter, and it is from this fluid endochrome, when cast loose from the plant, that the species is propagated. This lovely plant usually grows on the shady side of rock pools, and generally under shelter of some of the larger or membranous algæ. This reminds me not only of the exquisite groups of seaweeds one finds in every rock pool, but of one in particular near the end of the Southend pier, where many years ago, in my early seaweeding days, I found the first specimen of *Bryopsis plumosa* I had ever seen, growing in company with a charming filamentous Rhodosperm, and a finely iridescent plant of *Chondrus* or carrageen moss. On the occasion to which I refer, the rainbow tints thrown off by this plant, mingled with the green of the *Bryopsis*, and the crimson waving branches of its other companion, formed a submarine picture of the utmost grace and beauty. The

FIG. 24. *Bryopsis plumosa.*

decided rarity of this genus is the very delicate species *B. hypnoides*. I have found this plant at distant intervals of time and in widely different situations. For instance I met with it at Plymouth about twelve years ago, and in tolerable plenty; but in subsequent visits to the same locality I never saw a single specimen of it. At Torquay I hunted for it in vain for three seasons, when all at once I discovered it by the merest chance, growing in a rock pool at high water mark near the abbey rocks in Torbay. This appearance and disappearance of certain species of seaweeds is certainly very remarkable, and opens out a wide field of speculation on the probable causes of this singular caprice in the growth and irregularity of appearance in marine algæ. I have endeavoured in vain satisfactorily to account for it, but experience has pointed out to me two probable causes. In the first place I consider the disappearance of some species of rare seaweeds is due to the rapacity of inconsiderate collectors, who, when they meet with a rare plant, instead of being content with a portion of it, and leaving sufficient for the chance of its bearing spores, and thus producing a new crop, ruthlessly seize every specimen upon which they can lay their hands, and thus the species is lost, at least for a time. This, I am convinced, is the most general cause for the disappearance of *some* species, and another may probably be due to the fact that the plants, although growing in tolerable luxuriance and abundance, may not have been in fruit, and consequently perished without having been able to propagate their species.

FIG. 25. *Bryopsis hypnoides.*

The genus *Bryopsis* is ordinarily represented by the justly-admired species *Bryopsis plumosa*. Its companion, *B. hypnoides* (Fig. 25), is equally beautiful, much more delicate in its growth and general appearance, and is certainly a rare plant; indeed, I have heard more than one collector doubt that it existed otherwise than as a *book* species, or, at most, a permanent variety. One autumn I took one solitary specimen of the little gem, leaving a considerable portion of it still growing on a plant of *Corallina officinalis*, in an out-of-the-way rock pool. The following season I was

rewarded for my forbearance by finding in the same rock pool, and in another adjacent, quite a submarine plantation of this rare and lovely chlorosperm. The illustration is from one of the specimens of *B. hypnoides* taken by me in October, 1872, and I rejoice to say that it then exceeded in abundance—at least in Torbay—its beautiful but much more generally known companion. The little plumes of this species are extremely delicate, the ramuli are longer and more attenuated, and the whole plant is much more abundantly branched, though with less regularity, than *B. plumosa*.

There is a very curious plant which grows in immense quantities on some sandy shores, usually in shallow places, but sometimes extending into deep water, and from such situations it is cast ashore after storms, and rolled along the beach in great abundance by the in-flowing tide, forcibly reminding one of the long lines of grass in a newly mown field. The name of this plant is *Zostera marina*, literally "sea ribbon," but commonly known as "grass wrack," from its great resemblance to long blades of grass. *Zostera marina*, although growing in the sea, is not a seaweed at all, but in reality a plant with proper roots, deriving nourishment from the soil in which it grows, and bearing flowers, followed by seed. Its structure is very peculiar, for within the beautiful green envelope of its long ribbon-like blades, a series of white fibres traverses the plant throughout, but too brittle or wanting in tenacity to be of any real or permanent value as an article of manufacture. During the American war, when the supply of cotton failed, attempts were made to utilize this marine product, but, I believe, with very partial success. I have not considered it necessary to figure this plant, but as, from its abundance, collectors are certain to meet with it, I have given the above brief description of it chiefly for the benefit of young beginners in the science of algology.

Among the many parasitic green seaweeds that are more or less abundant, there are three or four species which must be described here for the benefit of amateur collectors, who otherwise might be occasionally puzzled to make out certain curious tufts of short filaments which infest some of the plants they gather for preservation. All of these parasitic algæ are beautiful microscopic objects, especially when they are examined fresh from the water, but their forms are so simple, and their structure so delicate that they shrink in drying almost past hope of identification. On a future occasion I may perhaps figure and describe all these minute plants, but at present I will call the reader's attention to a few only of the most common species, such as are pretty certain to be found on decaying *Ceramium rubrum*, in shallow pools, and on the terminal branches of *Halidrys* and other *Fuci* or rock-weeds. Among the latter there are two species belonging to the genus *Lyngbya*, which I have found very frequently infesting the terminal branches of *Halidrys siliquosa*, or the "podded sea-oak;" one of them, *Lyngbya Carmichaelii*, is represented in Fig. 26. It is found sometimes

growing on floating timber, and also on rocks, where its bright grass-green filaments, 3in. or 4in. long, are curved or twisted together in extensively interwoven masses. Under the microscope the endochrome at maturity presents a series of beautifully distinct lenticular or lens-shaped cells, which finally burst through the tubular envelope, and reproduce the species. Part of a magnified filament is represented at *a*, (Fig. 27); a ripe spore is escaping from the terminal cell. The genus *Lyngbya* was dedicated by Dr. Harvey to Hans Christian Lyngbye, a Danish naturalist, and this species was named in honour of Captain Carmichael of Appin, in Scotland, who discovered it. *Lyngbya majuscula*, very well represented in Fig. 28, is the largest of this genus, and strongly resembles, except in colour, long tresses of curling hair. Collectors sometimes call it "Mermaid's hair." It usually grows on muddy rocks between tide marks, but the finest specimens are thrown up from deep water. The filaments, which are densely interwoven, present, under the microscope, the appearance of a bundle of tiny snakes. The endochrome is of a dull green or sometimes inclining to purple, and is composed of numerous closely appressed ring-shaped cells, but here and there interrupted by a line as if broken, and sometimes separated into distinct joints, as seen in the two portions of magnified filaments at *b*, Fig. 27. *Lyngbya flacca* is another not uncommon species, being found on *Ceramium rubrum* and other algæ; but the filaments are so extremely fine, that it is next to impossible to represent them satisfactorily in a drawing; however, enough has been said of the plants of this genus to call the attention of collectors to a class of interesting species, too frequently disregarded simply because they require microscopic examination for an appreciation of their beauties, or because they are unattractive as book specimens.

FIG. 26. *Lyngbya Carmichælii.*

The genus *Calothrix*, or "beautiful hair," as its name literally signifies, contains some remarkably beautiful but very minute plants. The filaments of one of them, *Calothrix semiplena*, seen at *a*, (Fig. 29), when magnified, have a very singular appearance, the little tubes being, as it were, varie-

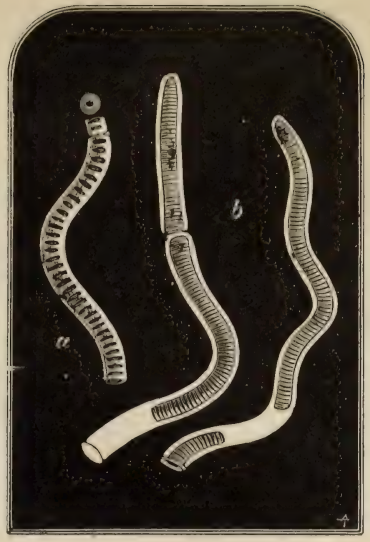


FIG. 27. (*a*) Filament of *Lyngbya Carmichælii*; (*b*) Filaments of *Lyngbya majuscula*.

FIG. 28. *Lyngbya majuscula*.

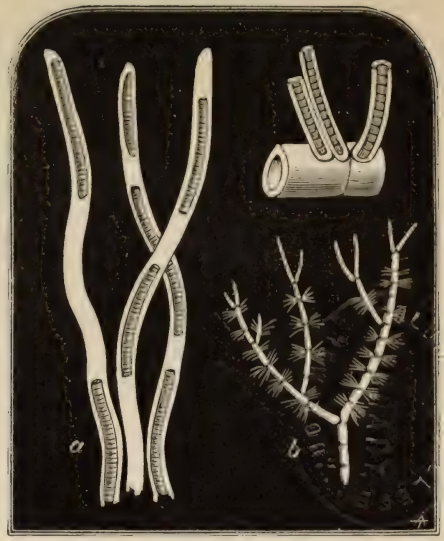


FIG. 29. (*a*) Filaments of *Calothrix semiplena*; (*b*) *Calothrix confervicola*.

gated, owing to the endochrome being separated here and there by empty spaces, as though the tubes were indeed only half full, a character so peculiar and constant, that it is referred to in its specific name. *Calothrix confervicola* infests some species of conferva, and also other small algæ in shallow tide pools. This plant is composed of little star-like tufts seldom more than a quarter of an inch long, but crowded on the branches of the seaweed, on which they are parasitic to such an extent, as sometimes to obscure every portion of it but the root. Little tufts of this parasite are represented at *b*, in Fig. 29, growing on *Ceramium rubrum*, and above it are two cells of the ceramium with the basal part of three filaments of the *Calothrix* highly magnified, to show its simple structure.

There are several other species of *Calothrix* still more minute and not so common as *C. confervicola*, and in addition to these two last described genera, there are some others containing very interesting species; but as several of them are found chiefly in brackish ditches oftener than in the sea, and others are inhabitants of fresh water streams or the margins of waterfalls, I shall, for the present, bid adieu to the Chlorosperms, and enter in my next section on a description of the Melanosperms or olive seaweeds.

SECTION II.

MELANOSPERMEÆ.

Olive Seaweeds.

THE olive seaweeds, though much less numerous than the red, greatly exceed the green plants in numbers as well as in size; and, although some few of the red and green weeds are used as articles of food, and for other purposes, the Melanosperms bring by far the largest revenue to man. As manure for the land nearly all kinds are equally serviceable, but in the manufacture of kelp, which is a coarse or impure carbonate of soda, the *Fuci* or large rock weeds, are especially valuable, while the various species of *Laminaria*, in combination with the *Fuci* and other olive weeds, yield mannite and a large amount of iodine. On the west coast of Ireland the poor peasants are almost entirely dependent on the seaweeds which are cast ashore, for manure in the cultivation of their potatoes; and in the Channel Islands, the "vraicking season" (as gathering seaweeds is called there) assumes the importance of a hop picking in Kent. In Norway, and in the north-west of Scotland and Ireland, some of the *Fuci*, such as *F. serratus* (Fig. 36) and *F. vesiculosus* (Fig. 37), are dried as winter provender for horses and cattle. On the south coast of Devon I have occasionally, while out on my algological excursions, seen a herd of cows descend from the fields to the shore and browse on the *Fuci* with great avidity.

The name "Melanosperm" or "black seed" is applied to that large class of olive-brown plants, several species of which, such as the well-known *Fuci* or Kelp weeds, are characteristic of most rocky shores; they form the leading feature of marine vegetation from high-water mark to half-tide level, while the *Laminariæ* or great oar weeds, are rarely uncovered by the tide, but vegetate from extreme low-water mark to several fathoms deep, where they form a broad belt of marine vegetation, usually termed the Laminarian zone. In clear weather, when the water is undisturbed, the long strap-like fronds of these seaweeds may be seen waving to and fro as the observer passes above in a boat. The gigantic algæ of the ocean depths are all olive coloured, and to these our largest *Laminaria* is but a pigmy, for the great *Nereocystis* of the Pacific Ocean is said to have, at maturity, a stem 300ft. long, bearing at its summit a huge barrel-shaped air-vessel, terminating in a tuft of about fifty forked leaves, each of which is above 40ft. in length. The large air-vessel supports this immense frond in the water, and here the *Lutra marina*, or sea otter, rests himself or hides among the leaves,

while he pursues his fishing. The alga which attains the greatest length on the British coasts, is that remarkable plant called *Chorda filum* (Fig. 49), or sea rope, often found in deep water, from 30ft. to 40ft. in length. Many an expert swimmer has lost his life while bathing among its slimy but tenacious fronds, whence its popular name in some localities of "dead men's lines."

Though most of the Melanosperms are olive coloured, especially when fully grown, many of them turn to a pale green, and others to a bright verdigris green, either when decay sets in or in drying. This is particularly observable in the young plants of the various species of *Laminaria*, all the *Desmarestiæ*, several species of *Ectocarpus*, and some others, a peculiarity which at first misleads young collectors, who imagine from the green tint of their mounted specimens that they have gathered Chlorosperms; however, *experientia docet.*

As all works on marine algæ commence with descriptions of the various species of *Sargassum*, or gulfweed, some mention of this remarkable plant will naturally be expected here; but it is not a British seaweed, and is only occasionally wafted to these shores, collectors rarely meeting with it anywhere but on the south coast of Cornwall, and even there mere fragments or seaworn specimens only are picked up among the *rejectamenta* of the sea. There are a large number of species of *Sargassum* in various parts of the world, but that which is known as "gulfweed," is the floating species *Sargassum bacciferum*, or berry-bearing sargassum, the so-called berries being really air-vessels which serve as floats to support the plant on the surface of the water; and it may be remarked that the vast fields of seaweeds which were first described by Columbus when he crossed the Atlantic, and which seriously impeded the progress of his small vessels, are met with at the present day in very nearly the same situation. These floating plants are not propagated by spores, but by *gemmæ* or buds; sprouts, in fact, that are thrown out from all sides of the old plant, thus *continuing* the life of the plant rather than *reproducing* it; those species only which grow on rocks being propagated by spores, which are produced in clusters of stalked receptacles.

The genus *Fucus* differs from all other orders of melanosperms in having their spores or reproductive bodies attached to the walls of conceptacles or spore cavities sunk within the substance of the frond, and communicating with the surface by means of a pore or minute opening. In *F. vesiculosus* (Fig. 37) these receptacles are filled with a slimy or gelatinous matter which, under the microscope, is found to be a beautiful network of jointed fibres (Fig. 30), and within the round hollow conceptacles which are immersed in the jelly-like masses, the spores in some, and antheridia in others, are produced. The endochrome, or whatever the spores consist of, is at first simple, or consisting of a single body or substance, but it subsequently divides into two, four, or even eight sporules. The antheridia are borne on branched filaments, which are also attached to the walls of conceptacles, but on separate plants, and these antheridia are filled with

active granules or spermatozoids, which, upon liberation from the antheridia, swim about by means of two vibratile cilia with which they are furnished, until they find the spores, around which they swarm, and upon which they finally settle, fertilisation of the spores being the result. The little ciliated bodies having performed their office, perish, and the spores begin to germinate and produce new plants of the species from which they sprang.

The process of development in the sporules of *Fucus vesiculosus*, and some others of this genus, is so extremely interesting that I will give a brief description of it in directing the reader's attention to the accompanying illustrations. Fig. 30 is a vertical cutting of one of the conceptacles of *Fucus vesiculosus*, showing the network-like filaments of which the fruit-bearing portion of the frond is composed, and the interior of the conceptacle or spore vessel; the spores in various stages of development seated among projecting filaments, and attached to the wall cells of the cavity, the pore or opening above being their means of exit. Fig. 31 contains more highly magnified portions of the filaments and cells, separated from the conceptacle, to show the gradual development of the spores, each of which is enveloped in a double transparent membrane. The under figure to the right represents the ruptured membranes, the spore having escaped into the water. In Fig. 32, on the left, is represented a spore fresh from a conceptacle, still enveloped in its double membrane, and exhibiting lines of separation into eight portions or sporules. The three next figures represent the complete separation and gradual development of the eight sporules, which assume by degrees a spherical form, and draw the inner membrane which incloses them upwards until it presents the appearance of a wine glass placed within a glass bowl. The central figure in the under line represents the sporules arrived at maturity, having ruptured the filmy membranes, and dispersing into the surrounding water. On the right is a sporidium, containing developing sporules and surrounded by spermatozoids. Fig. 33*a* represents a tuft of branched filaments from another conceptacle, several cells or joints of which are converted into antheridia filled with antherozoids or spermatozoids. The large round body (*b*) beside it is a spore, and ciliated granules are represented around and upon it. These minute objects are the spermatozoids, which under the microscope appear to be of oval form, but pointed at one end, having an orange spot in their centre, and being furnished with a filament at each end, by means of which they swim about until their brief existence terminates.

On rocky coasts or wherever seaweeds abound, the various species of the genus *Fucus* occupy the greater part of the shore from high-water mark to some distance below half-tide level, and thus as they are the first to engage the collector's attention, I will describe some of them at once.

High up on the rocks, sometimes even above the reach of the tide, but moistened by the spray and dash of the waves, grows the small but pretty species *F. canaliculatus* (Fig. 34). In some situations, where it is abundant and in fruit, the rocks upon which it grows present the most

FIG 30. Conceptacle of *Fucus vesiculosus.*

FIG. 31. Filaments and spores from conceptacle of *Fucus vesiculosus*, highly magnified.

FIG. 32. Sporules in various stages of development.

FIG. 33. (*a*) Branched filaments from conceptacle, bearing *antheridia*; (*b*) Spore surrounded by *spermatozoids.*

FIG. 34. *Fucus canaliculatus.*

picturesque appearance; the olive green of the channelled fronds of this species mingled with the golden tint of its clustered seed vessels, produces the most charming effect. The tufted fronds of this species are from 2in. to 6in. high, and are channelled on the upper side, but it has neither air-vessels nor midrib like some of its congeners. The fruit is contained in

FIG. 35. *Fucus nodosus.*

FIG. 36. *Fucus serratus.*

oblong wedge-shaped receptacles, which are produced at the tips of the branches; our illustration is from a fruited specimen. The root, as in most of the *Fuci*, is a slightly conical disk, which adheres very firmly to the rocks precisely in the same manner as a pneumatic bracket. Descending a short distance from high-water mark, the observer very soon meets with *F. nodosus* (Fig. 35), or the "knobbed wrack," which is stunted, and sparingly provided with air vessels until it is found in situations where it can float on the surface of the water for a considerable part of the day. Such specimens when fully grown are above 3ft. or 4ft. long, and the air vessels which swell out at intervals along the stem and branches are often fully as large as a plover's egg. These air vessels help to sustain the heavy fronds in a floating position, and when the tide recedes, and the plant is spread out on the flat rocks on some shores, pedestrians are often startled at the popping sounds under their feet as they tread on the air bladders of this rockweed. The illustration shows the plant in a fruited and barren condition. The fruit is contained in roundish stalked vessels of a bright yellow colour, which spring from both sides of the branches. The fronds have no midrib, and are quite smooth and glossy. The rare species, *F. Mackaii*, is found on the west coast of Ireland and Scotland, though not to my knowledge on the English shores. It is intermediate between the two foregoing species, and is easily distinguished from both by the form and position of its fruit vessels, which are pendulous, and are produced near the base of the branches. *F. serratus* (Fig. 36), or the

"toothed rockweed," is the most easily distinguished, and is the handsomest of its tribe. Although very variable in length, breadth, and colour, its regularly toothed or serrated margin affords a ready means by which this species is recognised at once. Air-vessels are absent in this species, but it has a very distinct midrib. The frond is flat throughout, and the fruit is produced in receptacles which terminate the branches. Our illustration is from a very characteristic but barren frond of this elegant species; the plant from which it was taken grew on the inside of the Plymouth Breakwater, and was upwards of 6ft. in length. *F. ceranoides*, or "horned-wrack," is one of the rarities of this group, and is found most frequently in situations where a fresh water stream runs into the sea. Its substance is far less tough than that of the other *Fuci*, and the whole plant is thinner and more delicate, both in the growing state and after it is dried. The midrib is very narrow but distinct, and there are no air-vessels. The fruit is produced at the tips of dichotomous or forked branches, which are set alternately along the sides of the main stem. The most abundant species of this group of seaweeds, which may be termed *par excellence* the "kelp-weed," since it is more extensively used in the manufacture of kelp and iodine, than all the other species of *Fuci* put together, is *F. vesiculosus* (Fig. 37). It is extremely variable in size and appearance, so much so in fact, that some writers have constituted varieties to characterise peculiarities of form. Specimens growing in salt marshes and near high-water mark, where they are only occasionally covered by the

FIG. 37. *Fucus vesiculosus.*

FIG. 38. *Halidrys siliquosa.*

sea, are very narrow in the frond, and often destitute of air-vessels; while those which grow in rock pools, or where they are constantly within the influence of the tide, and frequently submerged, are provided with numerous air-vessels, which are set in pairs, one on each side of the midrib. Plants which vegetate in such situations are often found from three to four feet

in length, and although, like all the *Fuci* which turn nearly black in drying, *F. vesiculosus*, in the living state, and during the fruiting season, is of a fine olive, inclining to green, the midrib being very distinct and of a darker tint, the air-vessels a pale yellow, and the terminal receptacles, which are elliptical and somewhat wart-like, are a bright orange. The illustration shows the situation of the air-vessels on the frond to the left. The lateral division on the right is terminated with receptacles.

Fig. 39. *Pycnophycus tuberculatus.*

Halidrys siliquosa (Fig. 38), or as its name literally signifies, "Podded sea oak," is a curious and very interesting plant. When cast ashore from deep water, this is a very handsome species, and it is much to be regretted that in drying, it not only loses its fine olive tint and becomes perfectly black, but in the course of a short time after it has been put away in the herbarium, the salt which is retained in its densely cellular tissue, oozes out of the pod-like receptacles and disfigures the specimen. The only way to avoid or to check this annoyance, is to soak the plant in fresh water for some hours before drying it, and then to place it between towels and keep it so for some time before finally drying and pressing it. Our illustration is from a terminal branch of a plant which was about four feet in length. The fronds arise from a small expanded disc, and vary in length according to the depth of water in which they grow. A stunted but pretty variety, about a foot in length, is met with in rock pools about half-tide level. The fruit is produced in long-stalked receptacles, which are somewhat constricted at the septa or divisions, the seed-vessels being made up of a series of chambers having distinct transverse lines of separation, each siliqua, or pod, being terminated by a mucro or projecting point.

Another curious species of fucus, of a fine clear olive colour which turns black in drying, is the plant called *Pycnophycus tuberculatus*, in Fig. 39, the fronds of which are from 10in. to 14in. high, rising from creeping fibrous roots which spread over the bottom of rock pools, and in some situations form perfect little submarine groves. Air-vessels are represented rarely present in this species, but when they are, as seen in the terminal branch of our illustration they are produced at the base

of the tubercled receptacle which contains the spores, and is itself composed of very compact cellular tissue. Professor Agardh includes this species with some others in a group which he calls *Fucodium*, but at present I have thought proper to describe it under its generally known name.

The genus *Cystoseira* contains some species which are tolerably abundant, at least on the southern coasts of Britain. The generic name of this group indicates a chain of cysts or bladders, of which the branches of all these plants are chiefly composed. The roots of all are thick and woody, the stems are short and cylindrical, and are beset on all sides by numerous slender branches variously divided and clothed throughout with little spine-like ramuli. In our illustration of the species, *C. ericoides* (Fig. 40), which is very heath-like (whence its specific name), the air-vessels are very small and are produced near the tips of the branches. The receptacles are also terminal and spiny. The fronds are from 1ft. to 2ft. high, and when seen growing in shallow pools with the sun shining full upon it, the whole plant is beautifully iridescent. Young collectors who see this brilliant alga for the first time, are naturally enchanted with the exquisite glaucous tints which it reflects, but their delight is quickly dispelled, for upon removal from the water, it is found to be of a dull brown olive, all the full rich tints of blue and green, more like the phosphorescent gleams that flash from some of the marine animals than any vegetable colours, vanish the moment the plant is removed from its native element. *C. fibrosa*,

FIG. 40. *Cystoseira ericoides.*

FIG. 41. *Cystoseira fibrosa.*

very well represented in Fig. 41, is a handsome and very well marked species. The air-vessels are larger than in any other British species, and are produced in succession along the branches, but at some distance from

the tips. The receptacles are filiform or string-like, and are produced at some distance beyond the air bladders; the branches being all set with one or two series of slender ramuli; those which clothe the tips being long and bristle-like. Specimens thrown up from deep water on the South Coast of Devon are often above 3ft. in length. *C. granulata*, which is not so common as the two foregoing species, may be known by the branches, which are long and very slender, having a hard bulb-like knob situated at the base of each of them. In the species *C. fæniculacea* these knobs are absent, and the branches are long and very slender, and towards the base are generally bare of ramuli, but in the upper parts are clearly set with numerous bushy, much divided, secondary branches. All the species are natives of the southern coasts; they are perennial, and are in perfection during the summer months. *C. barbata* is a very doubtful native of these shores. It is usually included in the British lists, but I have never seen or heard of a specimen having been taken in a growing state on any part of the coast of England. It grows abundantly in the Channel Islands, and is sometimes found cast ashore in a fragmentary state near Brighton. All the *Cystoseira* are difficult to display satisfactorily on paper; they require much judicious pruning of the branches, and should be soaked in fresh water until the salt is well melted out of them, and the stems and branches have become limp and manageable. The specimen should then be dried between towels or several folds of strong linen, and afterwards pressed. If they do not adhere to paper after some days of pressing, the under side of the plants may be gummed, or a mixture for the purpose may be made by dissolving isinglass in spirits of wine and applied with a brush.

FIG. 42. *Himanthalia lorea.*

Himanthalia lorea (Fig. 42), commonly called "sea-thongs," "sea-strap," or "sea-branch," is a plant concerning the duration of which botanists have been at variance, some asserting that the whole plant is annual, others describing it as biennial. I am of the same opinion respecting it as Dr. Harvey, because, like that eminent algologist, I have proved from actual observation that this singular alga does not produce its long forked strap-like fruit-bearing receptacles until the commencement of the second year, which then rapidly attain their ordinary size, perfect their fruit, and soon after decay and fall off. Wherever this curious plant vegetates, it is generally gregarious, groups of the little cones or top-like fronds growing amongst others which have

thrown out their long receptacles, and covering the rocks near low water mark in vast numbers. These little top-shaped plants gradually collapse on the upper surface and become plano-concave, extending into a perfect circle, and finally curling over a little at the margin. From the centre of this now cup-like disk, in the spring of the next season, two little mammillæ gradually arise, which rapidly grow out as described. The illustration represents the cup-like disc and the early condition of the lorea or seed vessels. These long strap-shaped seed-vessels, for such they really are, attain occasionally a length of 10ft. or 12ft, and within their soft inner substance numerous spherical receptacles are produced, which appear to the naked eye like little dark brown spots dotted about throughout the whole length of the thongs. *Himanthalia*, like some other species of *Fucus*, has a high northern range, being found in the Arctic sea, but they are more generally abundant in temperate waters; and, although the British species of *Fucus* are not numerous, yet, from the gregarious habits of most of them, they cover a larger extent of rocky shores than all the rest of our sea-weeds put together.

The *Laminarieæ*, although of an inferior order in point of structure and fructification to the *Fucaceæ*, are of much larger dimensions. Several species, when fully grown, are above twelve feet in length, but when we come to the deep-sea species, the fronds are measured by fathoms, and not by feet. I have already described the great *Nereocystis* of the North Pacific, with its large air vessel, the favourite resting-place of the sea-otter. This, and several other ocean species, rival in size the giant palms of the tropics.

The *Laminarieæ* are mostly plants of deep water, the larger species rarely vegetating above low-water mark. On the British and American shores they are popularly known as "oarweeds," "tangle and cuvy," "sea-colander," and "devil's apron." All the plants of this order are inarticulate or unjointed, the spores being produced in cloudy patches, or covering the whole surface of the frond. The root consists of numerous clasping fibres, additional ones being thrown down from above the older ones as the plant increases in size, and so firmly do they grasp the substances on which they grow, that often in boisterous weather tufts of this species from 4ft. to 8ft. in length are cast ashore, attached to large stones many pounds in weight, which their strong holdfasts have enabled them to drag from deep water. The well-known species of the south and east coasts of England, *Laminaria saccharina* (Fig. 43), or the sugary Laminaria, in allusion to the sweet, though insipid flavour of its frond, is often found cast ashore after storms; its long ribbon-like fronds being from 6ft. to 12ft. or more in length. When young, the colour of this plant is a pale green olive, but as it advances in growth, it gradually assumes the normal tint of its species, but varying occasionally from dark yellow to brown or brown olive. The stem, which in early growth is very short, increases in length with the growth of the frond, and in perennial species

the plant is renewed by growth from the tip of the stem, a new frond arising from the base of the old one, which developes and pushes the old frond before it, which finally drops off. This species may easily be distinguished from the others of its tribe by its more or less waved or curled margin, and by the central portion of the frond being divided, as it were, by transverse partitions placed at regular distances throughout the whole length of the plant. Fig. 43 represents a group of young fronds of this species. In the Arctic Sea, and on the coast of North America, there is a noble plant of this widely dispersed group, the stem of which is 8ft. long, and the broad plate-like frond is as large as a good-sized table cloth. Portions of this great *Laminaria* are occasionally cast ashore on our northern coasts, having been floated hither from Greenland or the

Fig 43 *Laminaria saccharina.*

American coasts by the Gulf Stream. The name of this alga is *L. longicruris.* On the South African coast there is a very remarkable species of *Laminaria,* of the beautiful genus *Ecklonia,* known there as the "Trumpet-weed." The native herdsmen make use of its long hollow stem, when dried and fashioned for the purpose, as a trumpet for calling the cattle together in the evening—performing, in fact, a *Ranz des Vaches,* like the herdsmen of Switzerland. A very beautiful and graceful species of this genus, though regarded by some botanists as a *variety,* and by others as the *young,* only, of the *L. saccharina,* is described by Dr. Harvey under the name of *L. phyllitis* (Fig. 44), and, although I must confess there is a strong resemblance between it and young plants of *L. saccharina,* there are certain

points of difference which I have observed in all stages of its growth, sufficient, in my opinion, to establish it as a species distinct from *L. saccharina*. The substance is more delicate, the colour paler, inclining to a greenish yellow ; the stem much shorter, even in older plants, and the base of the frond, where it expands from the stem, invariably wedge-shaped ; the frond itself being of a more equal width throughout, but tapering gradually towards the tip. It is usually found in rock pools about half-tide level. A frond of this graceful plant is represented in the centre of Fig. 44. It was growing in society with a tuft of *Chorda lomentaria*, a species which will be described shortly. *L. fascia* (Fig. 45), the band or ribbon laminaria, always grows in tufts, and mostly in rock pools where there are little sandy nooks, in which it loves to dwell. The stem is very short, and expands gradually into the membranaceous dark olive frond, usually from 4in. to 10in. long, but rarely more than an inch in breadth. Fig. 45 represents a very characteristic tuft of this species. *L. debilis* is a variety of this species ; it may be known by its greater breadth, the frond expanding from the very short stem much more suddenly. This variety is occasionally mistaken for narrow forms of *Punctaria latifolia* (Fig. 65), from which, however, it may be distinguished, with the help of a lens, by its densely cellular structure, *Punctaria* having a reticulated or network-like surface, and generally dotted over with *sori* or groups of spores.

The species of *Laminaria* already described are, in all stages of their growth, long, simple, or undivided plate-like fronds, produced from a solid cylindrical stem ; but the two, which I am about to describe, are (except in very early growth, when produced from spores) cleft into numerous long strap-like segments, a short distance above that portion of the frond which expands abruptly from the thick round stem. Fig. 46 represents the well-known species *L. digitata*, taken from a small but very characteristic plant which grew on the Castle rocks at Hastings, a considerable distance above low-water mark (hence its small size), the ordinary habitat of this species being from extreme low-water mark to several fathoms deep. In our illustration the lower part of the frond is seen to be very much bulged out, the plant in fact being about to produce a new frond—the lower portion, in the course of time, expanding, lengthening, and separating into a digitated frond, precisely similar to the upper part, to which it is still attached, but which gradually turns black and falls off as the new frond approaches maturity. Fig. 47 represents the variety *Stenophylla*, or narrow-leaved Laminaria, the frond being usually cleft into two or more narrow segments down to a very short distance above its long round stem. The roots or holdfasts of these large seaweeds grasp the rocks so firmly as to defy all efforts to remove them. I have frequently pulled away in vain at an unusually fine or perfect plant ; the frond or stem even breaking away, but not a single grasping fibre relaxing its hold. *L. digitata* is the plant which, in addition to *Rhodymenia palmata*, is sold in the streets of Edinburgh and elsewhere in Scotland ; the people who carry

these seaweeds about, crying, "Wha'll buy dulse and tangle?" Dulse is one of the best of the edible seaweeds, and is eaten very generally in the

FIG. 44. *Laminaria phyllitis and Chorda lomentaria.*

FIG 46. *Laminaria digitata.*

north. Tangle is the common name of the *Laminaria*, the dried stems of which are used by the poor Scotch for fuel. *L. bulbosa* (Fig. 48), popularly

FIG. 45. *Laminaria fascia.*

FIG. 47. *Laminaria digitata*—var. *Stenophylla.*

known as "Sea-furbelows," when grown in deep water is the most bulky of its tribe. I have seen specimens on the Plymouth breakwater, cast up

from the deep after a storm, which upon being spread out, formed a circumference of nearly 40ft., the whole plant being as much as a man could lift from the ground. The large bulbous root of this species is often over 6in. in diameter, and the broad flat stem is deeply puckered at the sides for a foot or more above the bulb-like root; hence its popular name. A mature plant is represented at Fig. 48, the terminal portions of its deeply cleft frond being turned over, in order to show the large bulbous root and the puckered sides of the stem.

Chorda filum (Fig. 49), or sea-rope, or, as I have already stated it is sometimes called, "dead men's lines," usually grows in tufts, from a few inches in shallow rock pools, to many feet in length in deep water. At the base this long string-like plant is very little thicker than a hog's bristle, but it gradually increases in size, and tapers off again to an extremely attenuated point. Its structure is very curious, being cylindrical, but tubular within, though divided by transverse membranous diaphragms into distinct chambers. The outer surface of the frond is clothed with very soft colourless hairs, among which the spores are produced. A small variety, called *C. tomentosa*, is very densely clothed with these delicate hairs, but in this case the hairs are of a fine olive, turning to green in drying. Our illustration is from a young plant of *C. filum*, twined round like a coil of rope. *C. lomentaria*, as its specific name implies, is constricted, or tied in, at intervals. This species also grows in tufts, the fronds being rarely more than 12in. or 14in. in length. They are attenuated at each extremity, and the constrictions which occur at irregular intervals, give to the simple fronds of this species the appearance of a series of elongated bags strung together. Fig. 44 represents a tuft of this plant which was growing in society with a beautiful frond of *Laminaria phyllitis*, already described; a small parasite is seen on the tip of the lesser frond, this species being constantly infested with one or more parasitic Melanosperms. *C. lomentaria* is very common in rock pools, and on the surfaces of flat rocks and stones between tide marks.

Alaria esculenta (Fig. 50) is unquestionably the most graceful and elegant of the British *Laminariæ*. It is sometimes called the "Hart's-tongue Laminaria," from its similarity to the *Scolopendrium* or Hart's-tongue Fern. It is found in the greatest luxuriance on the northern shores of England, in all parts of Scotland, and on the north and west of Ireland. The frond is solitary, and is from 2ft. to over 12ft. long; the stem of the plant being continued as a midrib throughout. As the plant advances towards maturity the stem throws out from the middle on each side several long nerveless *alæ* or leaflets, somewhat club-shaped at the tips, in which numerous pear-shaped spores are produced, as represented by the dark lines in the *pinnæ* or winglets of our illustration. In Scotland, where the midrib of this plant is eaten, it is called "Badderlocks," and in the Orkneys "Honey-ware," and in some parts of Ireland, where it is also used as an article of food, it is called "Murlins."

The smaller and more delicate algæ generally produce their fruit in

summer or early autumn, while the larger kinds seem to prefer the winter months. The rapidity of growth observable in some of the larger species during the winter is truly surprising. A remarkable instance is related by the celebrated civil engineer, George Stephenson, who, in the autumn of 1813, was employed to erect a stone beacon on the Carr Rock, at the entrance of the Frith of Forth. The workmen, having cleared the rock of the seaweed growing upon it, chiselled the surface to prepare it for the masonry. On the approach of winter, operations were suspended until the May of the following year, when, to the surprise of the workmen, the rock was found to be again covered with seaweed. Most of the plants of the new crop were of the genus *Alaria*, many of which were from 4ft. to 6ft. in length, all of which must have been the growth of about eight

FIG. 48. *Laminaria bulbosa.*

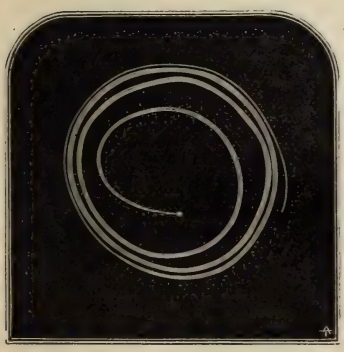


FIG. 49. *Chorda filum.*

FIG. 50. *Alaria esculenta.*

months, from the time that the very minute seeds had vegetated on the newly cut sandstone rock. I have often observed instances equally

remarkable of the rapidity of growth in marine algæ on various parts of the coasts of England,—rocks, which in December were comparatively bare, being in April or May of the following year covered with *Fuci* of various kinds, *Laminariæ*, and other species of algæ.

The *Sporochnaceæ* are a small but remarkably beautiful tribe of plants, six species only being found on the British coasts. Though chiefly characteristic of temperate waters, some of the species of this order are widely dispersed. *Desmarestia viridis* for instance, which is common on the shores of these islands, being found in the Antarctic Ocean, while *Desmarestia ligulata* (Fig. 51), also abundant on the British coasts, is found on the north-west coast of America, at Cape Horn, and at the Cape of Good Hope. *Carpomitra Cabrerœ* (Fig. 53c), which is said to be a native of New Zealand, is rare on our shores, being found only on the south coast of Ireland and in Plymouth Sound. These graceful plants are characterised as inarticulate olive-coloured seaweeds, whose spores are attached to external jointed filaments, which are either produced from the stems and branches in delicate tufts, or compacted together in long oval masses, some of which in early growth, as in *Sporochnus*, are terminated by pencils of thread-like filaments. As the plant advances in growth these delicate fibres fall away. In two species, *Arthrocladia villosa* (Figs. 53*a* and 54), and *Desmarestia aculeata* (Fig. 52), the summer and winter states of the plants are so widely different, that they are constantly mistaken for separate species, and deceived Linnæus himself. All the *Sporochnaceæ*, though of a delicate olive while growing, rapidly change to a verdigris green in drying, and have also the remarkable property of causing decomposition in all kinds of delicate algæ with which they are placed in contact. Collectors who are aware of this peculiarity should be prepared with a separate vessel or bag, especially for the *Desmarestia;* for all the plants of this genus decay very rapidly, and it is impossible to display their beautiful tufts of pencilled filaments when once decomposition has set in. Whenever I have had the good fortune to meet with fine specimens of any of this group of plants, I have rarely loitered on the shore, or cared to look for anything else, but hastened home with my treasures and mounted them on paper as soon as possible Although, as observed by Dr. Harvey, there is so much similarity in the structure and habits of these plants, a peculiar difference in the organs of fructification has obliged botanists to break up this order into two families; the first of which is *Arthrocladia*, the spores being attached to pencilled filaments which spring from the sides of the branches. First in this family stands the genus *Desmarestia*, named in honour of M. Desmarest, a French naturalist. It contains three beautiful species, which I will describe.

It is very remarkable that no fructification has yet been observed on any of the *Desmarestiæ*. Judging from analogy, one would expect to find it connected, in some way or other, with the lateral tufts of fibres abundantly produced in early growth; but until some fortunate discoverer

is able to announce the fact, we must be content to pronounce the fruit of this genus "unknown."

Desmarestia ligulata (Fig. 51), or the strap-like Desmarestia, is the largest of its tribe. On rocks, where it is exposed at low water, beautiful specimens from 6in. to 12in. long, may be obtained, but plants which are cast up from deep water are often from 4ft. to 6ft. in length. This species may readily be known by its broad flat stem and branches. Though very variable in breadth, the branches have all a linear lanceolate outline, and produce here and there, at their margins, numerous small ramuli or

FIG. 51. *Desmarestia ligulata.*

branchlets, bearing at their tips little tufts of delicate fibres. All the branches taper towards the base, and are placed exactly opposite to each other. The most beautiful growth of this fine species that I have ever met with may be found at extreme low-water mark on the lower rocks in Whitsand Bay, near Plymouth. Our illustration was taken from a superb specimen which grew in the above charming locality. *D. aculeata* (Fig. 52), is found on most of the British shores, though rarely in a growing state, being usually a deep water species. The spring or summer and winter

conditions of this plant are vastly different. Specimens which are met with in spring or early summer, whether growing or thrown ashore, are clothed throughout with tufts of delicate filaments, which fall away as the plant arrives at maturity. Old fronds of this species are destitute of these filaments, and the branches are set on each side with spine-like ramuli, hence the specific name, that of *aculeata*. In perennial specimens, when new branches shoot forth, they are always clothed with tufts of fine confervoid filaments, which are apparently a necessity in the progress of growth, and probably, as suggested by Dr. Harvey, perform in some way the office of leaves in higher plants. The root of this species is a small round disk, the stem short and cylindrical, and the branches long, numerous, repeatedly divided, and irregularly set with a second and third series of branches and branchlets. Plants from deep water are often over 3ft. long. Smaller specimens, when carefully mounted, are extremely beautiful, especially when the marginal tufts of fibres are well displayed, for in drying they change from olive to a brilliant green colour. No time must be lost in putting this species under pressure, as decomposition takes place very soon after its removal from the water. Our illustration is from a slightly magnified portion of a fine specimen cast ashore at Brighton many years ago. *D. viridis* is the most delicate, and in its summer dress the most attractive of its tribe. The whole plant is much more slender; it is repeatedly and excessively branched, all the branches being set exactly opposite and gradually attenuated towards the tips, the terminal branches and ramuli being more and more slender and capillary or hair-like. The olive tint of this lovely species changes very quickly to a delicate green, and it closely adheres to paper in drying. *D. viridis* is a summer annual, and is usually found in rock pools between tide-marks; sometimes on stones in the sea, and occasionally on the larger algæ. In addition to the three species of *Desmarestiæ* just described, there is another which, until very lately, has been considered a plant of extreme rarity. Its name is *D. pinnatinervia*, in reference to the wing-like nerve which traverses the frond in the manner of an obscure midrib. In outline and general appearance this rare alga bears some resemblance to a *Punctaria*, being unbranched and leaf-like, but having a short though distinct stem. It is taken off the Cornish coast, but on no other station on the English shores that I am aware of.

The genus *Arthrocladia* is represented by one species, viz., *A. villosa* (Fig. 53*a*). The name, *Arthrocladia*, signifies "jointed branch," the stem and branches being furnished at close intervals with nodes or knob-like swellings, from which are produced whorls of delicate tufts of branched filaments, to which the specific term of *villosa* specially refers. The spores of this plant are produced in pod-like vessels, borne on the pretty tufted filaments which in early growth adorn the stem and branches. Fig 53 *a*, represents a portion of the stem, magnified to show the situation and form of the whorls of branched filaments. At maturity the spores break through the membrane which incloses them, and, like the pencilled filaments on which the

FIG. 52. *Desmarestia aculeata.*

FIG. 53. (*a*) *Arthrocladia villosa*; (*b*) *Sporochnus pedunculatus* (*c*) *Carpomitra Cabreræ.*

strings of fruit vessels are borne, fall away, leaving the stem and branches of the plant rigid and bare. This beautiful plant is a summer annual, and is by no means common, though widely dispersed. Fig. 54 is from a very fine specimen taken by me at Hastings several years ago.

The second family of this order, *Sporochnaceæ*, contains two British species only. The spores of these plants are produced in knob-like receptacles composed of whorled filaments, appressed or closely compacted together. This small group of plants takes its name from the genus *Sporochnus*, which signifies *wool* and *seed*, because tufts of woolly fibres are connected with the organs of fructification. In *Sporochnus pedunculatus* (Fig. 55), these tufted fibres form a crest to the elliptical spore-vessels which spring from each side of the stem and branches, to which they are attached by a peduncle or stalk, as seen at *b*, Fig. 53. "Few of our marine algæ," remarks Professor Harvey, "are more attractive to the eye of a botanist than this beautiful plant, when it is seen waving its graceful branches in the water, and its pear-shaped seed-vessels are terminated by their tufts of olive-green filaments." A portion of this species is represented at Fig. 55. This plant is dredged in Plymouth Sound, where it grows abundantly and in the greatest perfection. Its length is from 6in. to 1ft. or more. The main stem is filiform or string-like, and is scarcely any thicker than the long slender branches which are thrown out on each side, getting gradually shorter as they approach the tip of the stem, thus giving to the plant an extremely graceful and elegant outline. This species is by no means common, but in some seasons it is cast ashore a Brighton rather plentifully, though of small size; it is also met with pretty generally every spring in the Channel Islands. As this plant is a summer annual, the spores ripen rather early in the season, and as the pre ty tufts

FIG. 54. *Arthrocladia villosa.*

of filaments soon fall away, collectors should look for this species in April and May, when the spore vessels are tolerably well developed, and the plant is in perfection. Its colour is a brownish olive, which changes to a yellow green when the plant is mounted on paper, to which it adheres closely in drying.

Carpomitra Cabrerœ, the last in this group, is one of the rarest of our seaweeds, being dredged in Plymouth Sound only, and sometimes cast ashore off Youghal, on the Irish coast. This singular plant arises from a tuber-shaped root. The branches, which are numerous and irregularly forked, are flat, and are furnished with an obscure midrib. They are usually erect, rather narrow below, but gradually widen upwards, the terminal branchlets having blunt or rounded tips, others being truncated, or cut off, as it were. The spore vessel, which has a fanciful resemblance to a bishop's mitre (hence the generic name), is seated on the tip of some of the lateral branches, and the round oblong spores which are produced within this curious receptacle, are attached to horizontal branching filaments whorled round an axis or central column, the whole forming an extremely interesting study for microscopic examination. Fig. 53 *c*, represents a branch with mitriform fruit vessel; beside it the fruit vessel, highly magnified. The specific name of this plant is in honour of Signor Cabrera, a Portuguese naturalist. There are several species of Carpomitra on the Australian coasts. The rarity of the plant on our coasts has been already referred to. It has never, so far as I am aware, been taken on any other British station besides the two mentioned above.

FIG. 55. *Sporochnus pedunculatus.*

The *Dictyotaceæ*, most of which I shall describe, are a group of plants of a leather-like substance, the fronds of which are spotted here and there with sori or groups of spores or spore vessels. The surface of all of these plants is seen, even under a moderate magnifier, to be highly reticulated, the characteristic term, *Dictyotaceæ*, which signifies a network-like appearance, being more or less applicable to the whole order. Some of these plants are flat, undivided, and expand into a broad or

Fig. 56. *Cutleria multifida.*

Fig. 57. *Haliseris polypodioides.*

fan-shaped outline. Others are tufts of simple bag-like fronds, being hollow within but closed at both ends, the apices being blunt or rounded, and the bases attenuated to a fine point, the roots of such being nothing more than a minute disk. In some the fronds are flat, but pinnated or divided by repeated forkings, while in others a distinct cylindrical stem throws out on each side numerous branches, some of which are hollow, while in other species the branches are solid. In no instance is there among this assemblage of plants an approach to leafy form or structure, as in the *Delesserieæ*; and in one genus only do we find a distinct midrib. This occurs in *Haliseris*, or sea-endive, a remarkably beautiful plant, in which the midrib is strong and wiry, the delicate membrane on each side being frequently found in a lacerated condition, owing to its extreme tenuity.

Some of these elegant Melanosperms reflect prismatic colours, a peculiarity specially observable in *Padina pavonia* (Fig. 58) when seen growing in shallow rock pools under the influence of sunlight. This is due to the finely articulated hairs with which the segments of the plants are clothed, which decompose the rays of light and thus throw off the lovely glaucous tints so often described. With the exception of the *Fucaceæ* this is one of the most extensive orders among the Melanosperms, and some of the species are among the most attractive of our native algæ. Some are of small size, though none of them are microscopic, while a few of the deep water species attain a length of several feet. In deep land-locked bays the species *Asperococcus Turneri* grows to a length of three or four feet, although the same species when found growing in rock pools between tide marks, rarely exceeds eight or ten inches.

The *Dictyotaceæ* are more abundant in the warmer and more sheltered parts of the sea than in colder regions. The species which reach high northern and southern latitudes are few, while, on the contrary, they increase in number and luxuriance as they approach the tropics. *Padina pavonia* and some others abound in warmer climates, the former being met with in the Mediterranean and in the Channel Islands in great quantity, its northern limit being the southern shore of England. *Dictyota dichotoma* (Fig. 61) is found in all seas from the antarctic lands to the tropics. *Haliseris* and *Zonaria* are the only English representatives of the beautiful genera to which they belong, most of the others being natives of warmer latitudes.

For convenience of description, I intend to divide this order into three separate groups. The first of which contains plants having flat fronds, many of which are cleft or divided, but rarely branched. In the second, the fronds are cylindrical and branched. The third containing plants with tubular, or flat, and unbranched fronds.

At the head of the first division of the *Dictyotaceæ*, is placed the beautiful species *Cutleria multifida*, finely represented at Fig. 56. This is a deep water species, and was discovered at Yarmouth by Mr. Dawson Turner in 1804, and was dedicated by Dr. Greville to Miss Cutler, of Sidmouth, in

acknowledgement of that lady's contributions to botanical science. The frond of this plant is from 3in. to about 20in. in length, and is cleft into numerous wedge-shaped lobes, each of which is cut from the tip downwards, the terminal incisions being gradually narrower and the tips somewhat acute or pointed. These characters are well expressed in the specific name, that of "multifida." The fructification is of two kinds on distinct individuals, and is usually scattered over both surfaces of the whole frond. Antheridia, when present, are attached to small tufts of filaments, which are produced in the same manner and occupy the same position as the sori or groups of spores. These are developed in little tufts, each tiny filament of which contains several sporules, usually eight, placed in pairs each under the other. The plant is a summer annual, and is found pretty generally on the coasts of England and Ireland, though rarely in Scotland. *Haliseris polypodioides*, or sea-endive, represented

FIG. 58. *Padina pavonia.*

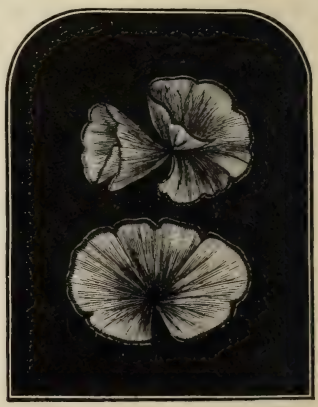


FIG. 59. *Zonaria collaris.*

merely by a branch or two at Fig. 57, is rarely found in perfection except with the assistance of the dredge. I have taken this beautiful plant at Ilfracombe, and in Plymouth, and Torbay in fine condition, but in each instance it was growing in pools under the shelter of over-hanging rocks at extreme low-water mark. The fronds are tufted, from 4in. to 14in. high, and divided in a dichotomous manner, or, by regular forking of the branches, all of which are traversed by a strong percurrent midrib; a peculiarity which sometimes gives it the appearance of young plants of *Fucus vesiculosus* (Fig. 37). The fructification is curious, being of two kinds on separate plants. In one, the spores are produced in oblong spots on each side of the midrib, somewhat in the manner of the fruit of the common fern, *Polypodium vulgare*, whence the specific name of *Haliseris*. In the other form of fructification, the spores are scattered singly and irregularly over the surface of the plant. The substance of the membrane of *Haliseris* is

very thin, and only the tips or younger portions adhere to paper in drying. The colour of the living plant is a brownish olive, but the terminal divisions change in drying to a very delicate tint of yellowish green. This species is said to be biennial, and is in perfection in July.

Concerning that remarkable plant called *Padina pavonia* (Fig. 58), Dr. Harvey has observed, "it is without parallel among seaweeds." The outspread fronds of this magnificent alga resemble variegated feathers, and the curved lines which adorn the surface, together with the beautiful fringe of golden-tinted filaments which ornament the upper margin of the fronds, have suggested the picturesque and highly appropriate specific name of *Pavonia*, or the Peacock. In the pretty village of Shanklin, in the Isle of Wight, near where this lovely plant grows in abundance, I have heard it called "Prince of Wales' Feathers." Our illustration is from a tuft of this species which grew in one of the prolific rock pools on the shore at Shanklin. This plant is a native of the tropics, and is abundant in the Mediterranean and the Channel Islands, its northern limit being the southern shores of England. Its favourite place of growth is in shallow tide pools, where it can bask in the sunlight during the recess of the tide. When viewed thus growing under water it is a truly exquisite object, for the golden fringes of its curved segments decompose the rays of light and reflect the most beautiful rainbow tints. The fruit consists of long lines of dark olive spores produced beneath the outer coating of the frond along the concentric zones, which at maturity burst through the membrane, each spore finally separating into four parts or sporules. The under surface of the fronds is covered with a whitish or pale blue powdery substance; and in mounting large tufts of this plant, a pretty effect may be produced by reversing some of the fronds so as to contrast the greenish olive of some with the blue-greyish tint of others, care being specially taken to secure those plants which are well provided with the beautiful fringe already described, the golden tint of which in summer plants, is invariably preserved in drying.

The genus *Zonaria*, from the Greek word for a girdle or zone, contains two curious species; one of which, *Zonaria parvula*, is found occasionally on various parts of our coasts, its usual habitat being in rather deep water on the stony nullipores. Hence its rare appearance unless cast ashore after storms. Our illustration, Fig. 59, is from two fronds of the species *Z. collaris*, the collar-like zonaria. This singular plant grows on rocks, to which it is attached by numerous woolly fibres, which spring from the under surface of the primary fronds. The secondary frond or upper portion of the plant, as seen in the upper figure of our illustration, springs from the lower or procumbent frond, and is usually cup-shaped, slightly notched at intervals, and terminated with a border or fringe of delicate fibres. The fruit is produced from beneath both surfaces of the frond, which at maturity, bursts through the cuticle or membrane of the plant, and is found to consist of sori or groups of spores concealed among numerous jointed threads or filaments.

Taonia atomaria, very well represented at Fig. 60, is one of the most attractive of the British Melanosperms. In England it is completely a summer plant, attaining perfection in July, and perishing by the end of September. The outline of the expanded fronds is usually fan-shaped, the terminal divisions being cleft and jagged similarly to those of *Cutleria multifida* (Fig. 56), the tips being truncated, or cut off as it were. The brown olive wavy lines on the frond so strongly resemble the transversely marked feathers of the pheasant, that a celebrated botanist proposed the name of *Phasiana*, and it is much to be regretted that this name was not adopted, for it is certainly more characteristic than that of *Taonia*, which is a name from the Greek signifying "Peacock." The spores are contained in sori or groups, which form indeed the wavy lines that adorn the fronds of this favourite plant. The spaces between these lines of fructification are dotted here and there with spores, scattered singly or sometimes in groups. *Taonia* is widely distributed, though it is nowhere abundant. The finest specimens are obtained on the south coast of Devon, and especially so in rock pools between tide marks east of the Plymouth breakwater.

Fig. 61 is from a very characteristic plant of *Dictyota dichotoma*. The frond being regularly dichotomous, or branched by repeated forkings from the very base, the segments becoming gradually narrower and smaller as they approach the terminal divisions. This pretty plant is one of the most widely dispersed of its order. In size and colour it differs greatly, according to the depth in which it grows. Specimens from deep water are broad and of a light brownish tint, and attain a height of a foot or more; while those which grow in rock pools about half-tide level are a few inches only in length, very narrow, and of a greenish olive. In these situations, too, may frequently be found, growing abundantly, the curious variety called *Intricata*, the very narrow, curled, and entangled fronds of which are a puzzle for the most patient manipulator to display properly on paper. The fructification of *Dictyota* is produced on both surfaces of the frond, and consists of groups of egg-shaped spores; or, on other plants of the same species, spores scattered singly on all parts of the fronds. Both forms of fructification are well represented at Fig. 62 (*a* and *b*), and here, also, may be seen the characteristic structure of the surface membrane of the *Dictyotaceæ*. The term being from the Greek for a net, in reference to the reticulated surface of these plants when viewed under the microscope. Both varieties of *Dictyota* are annuals, and are common all round the British coasts.

The four plants which I shall now describe, belong to that group in the *Dictyotaceæ*, in which the fronds are cylindrical and branched, the roots of all being a minute disk, destitute of fibres. First in this small assemblage of plants I must introduce the curious species *Stilophora rhizodes*, the generic name being from the Greek, signifying point or dot-bearer, in reference to the peculiar dot-like form of fructification, which is seated on the branches and ramuli of the plant from the base to the tips of the ultimate branchlets. The difficulty of giving a characteristic

FIG. 60. *Taonia atomaria.*

FIG. 61. *Dictyota dichotoma.*

or satisfactory illustration of this species in its ordinary growing state, has induced me to be content with figuring a magnified portion of the stem, on which are seated several sori or bunches of moniliform or necklace-like filaments, as seen at *c* (Fig. 62) and at *d*, a more highly-magnified portion of one of the sori, showing three spores seated at the base of the filaments. There is no mistaking this plant when it has once passed under observation. It is usually found near low-water mark, on rocks, or sometimes on other algæ. It is a summer annual, and occurs on various parts of the English and Irish shores, but is more abundant

FIG. 62. (*a.*) and (*b.*) Forms of fructification of *Dictyota*. (*c.*) *Stilophora rhizodes*. (*d.*) Magnified portion of sori of *S. rhizodes*. (*e.*) *Stilophora Lyngbyæi*.

in the neighbourhood of Plymouth than any other locality that I have ever visited. The fronds are from 5in. to 6in.. or sometimes nearly 2ft. in height. They are filiform or string-like, and generally excessively branched, the primary branches springing irregularly on each side of a more or less evident main stem. The colour of this plant is an olive brown, turning to a dark green in drying. The much rarer species or variety, known as *Stilophora Lyngbyæi*, is only, so far as my experience goes, obtainable by dredging in sheltered bays from ten to fifteen fathoms. It is said to be abundant in many places; but I have never taken it, even in dredging, any-

where but in Lamlash Bay, in the Isle of Arran. Professor Harvey considers it to be merely a deep-water form of *Stilophora rhizodes*, and perhaps, indeed, it is nothing more; but, like other Melanosperms in similar situations, its growth and general appearance differ from the typical form of the genus in having fronds of much greater length, the axils or angles of the branches being more rounded, the tips of the branchlets much more attenuated and pointed, and last and most important of all as regards specific distinction, the spores are seated on branched filaments, as seen at *e*, Fig. 62, and not at the bases of simple filaments, as in *S. rhizodes*. The colour is a pale olive-brown turning to a light greenish olive in drying. The genus *Dictyosiphon* contains only one British species, *D. fœniculaceus*. The generic name signifies a reticulated siphon—the surface of the stem and branches of the plant being reticulated, the network-like markings being, on this species, exceedingly fine. I have usually found this pretty annual, during the early summer months, in rock pools, and sometimes growing on other seaweeds. The frond, which arises from a small disk-like holdfast, is filiform or string-like, from 6in. to over 2ft. in length. The whole plant is excessively branched and bushy, and every branchlet is attenuated at its extremity to an exceedingly fine point. Fig. 63 is from a very well displayed specimen of this species. The fructification, which is rare, consists of little egg-shaped spores, which are scattered irregularly on various parts of the surface of the frond, but generally on the main stem. The plant from which our illustration was taken, grew in one of the sheltered bays in Plymouth Sound. It represents the early summer state of the species when it is in perfection. The colour is a light olive inclining to brown, but it turns to a pale green in drying.

The genus *Striaria* also contains only one species. It is found occasionally between tide marks, though more frequently in five or six fathom water. The root is a little bag-like disk. The fronds, which are tufted, are from a few inches to about a foot high. The main stems are set throughout with numerous branches which are mostly opposite and are all more or less similarly branched, every portion being attenuated alike at each extremity. In addition to the ordinary reticulation of the surface, the frond of this species, when in fructification, presents an extremely pretty appearance, every portion of the plant being marked with striæ, or transverse lines or bands, which are placed very close to each other, and are composed of sori or clusters of spores, the peculiar arrangement of which has suggested the generic name, that of *Striaria*, the specific name of *attenuata*, being equally characteristic of the form of growth of its branches and ramuli. *Striaria attenuata* is well represented in Fig. 64. The plant was taken by me at Plymouth many years ago, and although very perfect in form, the pretty transverse bands of spore clusters were not developed upon it. The colour is a pale olive, but in drying, young plants turn to a beautiful shade of green, and but for the transverse markings, which are generally present on mature specimens, this species might occa-

sionally be mistaken for a delicate form of *Enteromorpha compressa* (Fig. 8). *Striaria attenuata* is found in the Mediterranean, and is said to be abundant all round the British coasts. I have, however, found it only on the south Devonshire coast, from May to July.

FIG. 63. *Dictyosiphon fœniculaceus.*

The third division of the *Dictyotaceæ* contains the concluding members of the order, some of which have flat, undivided, membranous fronds, others are tubular, and all are unbranched. The genus *Punctaria*, from *punctum*,

FIG. 64. *Striaria attenuata.*

a dot, in reference to the peculiar dot-like fruit of these plants, contains three species. The first of these is *Punctaria latifolia* (Fig. 65), a pretty summer annual, which grows in tufts on rocks and on other seaweeds in pools between tide marks. The illustration is from a tuft of this species,

which grew in one of the tide pools in Torbay, where it is usually very abundant. The root is a very minute disk; the fronds are from 3in. to 8in. or 10in. high, and when fully grown are somewhat more than 2in. in width. They are generally oblong, with broadly rounded tips, and are tapered suddenly at the base; the margin is generally flat, but sometimes waved or curled; the colour is a pale olive green, turning to a lighter tint of green in drying; though occasionally, if mounted fresh from the sea, this species preserves its natural pale olive tint. The spores are produced on both surfaces of the frond, and, under the microscope, are found to be partially concealed amongst tufts of little club-headed filaments. Fig. 66 represents two well-grown fronds of *P. plantaginea*, the plaintain-leaved punctaria. This species grows in tufts in rock pools between tide-marks. The fronds are from 3in. to 10in. long, but are much narrower than those of *P. latifolia*, the widest part being near the blunt or rounded tips, from which they gradually taper to the base, the root being a very small naked disk. The substance of this plant is thick and tough, and of a dark brown colour, a character which it retains in drying. It is rarely curled at the margin, the long narrow leafy fronds giving it somewhat the appearance of young plants of *Laminaria fascia* (Fig. 45), from which it may, however, be always distinguished by the fructification, which is usually abundantly present, scattered in spotlike groups over both surfaces of the fronds. It is a summer annual, and is found pretty generally all round the British coasts. *P. tenuissima* (Fig. 67, *a*) is the rarity of its tribe. I took a single specimen of it many years ago at Brighton, but have never found it since. It is said to be parasitic on *Zostera marina* the common *grass-wrack*, which is so abundant on sandy shores; but although I have examined thousands of specimens of this marine plant in various parts of Scotland, and all round the shores of England, I have never been rewarded with a single plant of *P. tenuissima*. Of course, I cannot presume to say that botanists are wrong in mentioning the fronds of *Zostera* as its parasitic habitat; I can only say I never found it growing on that plant, but I have found it on *Chorda filum* (Fig. 49), as represented by a portion of both in Fig. 67, *a*. The fronds, which grow in clusters all round the slimy sea-chord, are from 3in. to about 10in. long, and are about $\frac{1}{4}$in., or rarely more than $\frac{1}{2}$in. wide, gradually narrowing towards the tips and much attenuated towards the base, of a delicate and almost transparent substance, and of a pale olive colour, turning to a bright green in drying. No fruit has hitherto been detected on this species, and as my plants are all barren, I am unable to describe the fructification of this rare alga. The late Mrs. Griffiths, of Torquay, is said to have considered it as the young of *P. latifolia*, and perhaps the absence or rarity of fruit on this species may have led to such a conclusion. I, however, do not share that opinion. The only specimens of this plant ever found by me were growing in widely different situations to any in which I ever met with *P. latifolia*, and in all the numerous rock pools in which I have watched the growth and development

of *P. latifolia* and *P. plantaginea* I have never detected a single specimen at all resembling the plant known as *P. tenuissima*.

Another parasite, very commonly found on *Chorda filum*, is the string-

Fig. 65. *Punctaria latifolia.*

Fig. 66. *Punctaria plantaginea.*

like plant known as *Litosiphon pusillus* (Fig. 67, *b*), the generic name signifying slender tube. Multitudes of these tiny tubular fronds clothe the long floating alga, sometimes for several feet together, spreading out like

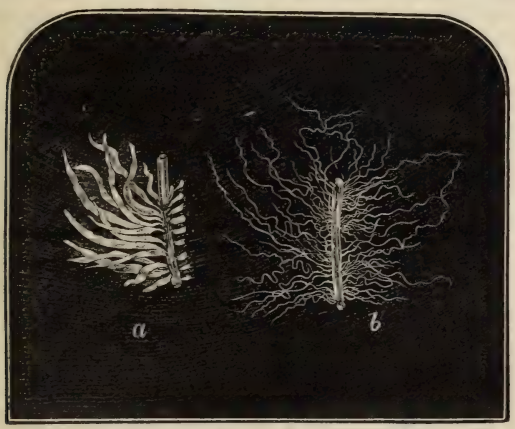


Fig. 67. (*a*) *Punctaria tenuissima* on *Chorda filum*, (*b*) *Litosiphon pusillus* on *Chorda filum*

the hair of a bottle-brush; in early growth perfectly straight, but as the season advances, they become lax, and are twisted or curled and everywhere entangled, as represented in the illustration. Oval spores are

produced on various parts of the tubular fronds, scattered singly or sometimes in pairs. In early summer this little thread-like plant dries a brilliant green; but in the mature state, as represented in our illustration, the endochrome of the cells having decayed or perished, the fronds turn to a brownish olive. The most effective manner of mounting this species on paper, is to cut a longitudinal slice of the *Chorda*, and place the cut side on the paper, taking care to spread out the fronds of the parasite while they are still floating in the water, which must be drained away gradually, raising one side of the paper at a time, or the limp fronds of the plant will either clot together or arrange themselves in an unnatural position. *Litosiphon laminariæ*, is an extremely minute parasite, whose place of growth is on the lamina or leafy part of *Alaria esculenta* (Fig. 50). It consists of little starlike tufts rarely an inch in length, and is scattered thus at very short distances apart, sometimes over the whole extent of the fronds of the Alaria. This little parasite being almost microscopic, is, as regards its fructification, completely so. The cellular structure of its tiny fronds is extremely beautiful though very simple. The cells are arranged in transverse bands placed very close together; and within these bands of cells the spores are produced.

The genus *Asperococcus* is named from the Latin and Greek, signifying rough fruit or seed; the spots of fructification, which are thickly scattered over both surfaces of the fronds of these plants, causing them to feel harsh or rough to the touch. They all vary in size according to the depth of water in which they grow. Fig. 68, represents a group of fronds of *Asperococcus compressus*, one of the rarest of this genus. This species is a summer annual. It is rarely found growing, being a deep water plant. I have taken it only in the neighbourhood of Plymouth. The fronds are from 6in. to about 20in. long. They are tubular but compressed or flattened at the sides, hence the specific name. The colour of this species is more inclined to a greenish tint than any other of the genus to which it belongs, and in drying, it invariably turns to a pale green, thus throwing out in strong relief the numerous oblong sori or spots of fructification. The flat growth of this plant renders it easily manageable in preparing it for the herbarium, and it closely adheres to paper in drying. *A. Turneri* is also rare. It is sometimes found in rock pools, but more frequently, with the help of the dredge, in sheltered bays, in five to fifteen fathoms. The fronds of this species vary in length from 4in. to nearly as many feet, the largest being obtained in deep water. They are like long inflated bags, constricted here and there at irregular intervals, and taper very suddenly at the base into a short stem, being attached to rocks or stones by a very minute naked disk. The colour is pale olive, becoming darker in drying, a character which is probably due to the minute dots of fruit, which are densely scattered over the whole surface of the fronds. *A. echinatus*, Fig. 69, is the commonest of its tribe. It varies in size, like the others of this genus, but the ordinary length its

its tufted fronds is from 6in. to 16in. It is found in rock pools between tide marks. The fronds are tubular, but here and there slightly con-

FIG. 68. *Asperococcus compressus.*

stricted, rounded at the tip and attenuated at the base, the root being a minute disk. The illustration represents a complete plant of the species.

FIG. 69. *Asperococcus echinatus.*

The colour in early growth is a pale olive, turning to a dark brown at maturity. The fruit is always abundantly produced, often completely

covering both surfaces of the fronds. Dr. Harvey mentions a variety of this species, called *vermicularis*, found by Mrs. Griffiths, in Torbay, the fronds of which are very narrow, and filiform or stringlike, and more or less twisted or curled. This variety is still abundant in various parts of Torbay, its habitat being in shallow rock pools about half-tide level. Young plants of this variety are sometimes very similar to undeveloped specimens of *Chorda lomentaria* (Fig. 44): the latter are, however, much smoother to the touch, and the colour is always a more decided greenish olive.

The *Chordariaceæ* are a group of plants which are usually characterised by botanists as olive-coloured sea-weeds, the fronds of which are, in some, of a gelatinous nature, while in others, the whole substance of the plants is cartilaginous, made up, as it were, of a crisp gristle-like body, which spreads over rocks and stones and adheres to them by its under surface. Some of these, as, for instance, *Leathesia tuberiformis* (Fig. 72), are sometimes found about half-tide level, covering the rocks in extensive masses of a light olive or yellow colour, heaped together like variously shaped tubers, and the same species is found frequently growing in small roundish groups on other seaweeds. Some others of this order are parasitic, composed of densely-tufted filaments, for the most part minute, some being entirely microscopic, the structure and fructification of which, when viewed under a high power, are wonderfully beautiful. Few of this order of plants are particularly attractive to the general collector, and many of them are extremely difficult to prepare for the herbarium. I shall, however, give a few directions as to the proper method of drying and pressing these plants as I severally describe them.

Some of the *Chordariaceæ* are very widely dispersed, a few of our common species, such as *Leathesia* and *Chordaria*, being found as abundantly on the South African shores and elsewhere, as on those of this country. In describing the British species of this order, I purpose grouping them together on the same principle which I observed in describing the three divisions in the *Dictyotaceæ*. Thus, the two first genera contain plants which have cylindrical branching fronds; the two next consist of tuber-shaped fleshy or cartilaginous masses; and the two last are dense tufts of unbranched thread-like filaments, in almost every instance parasitic on some particular species of seaweed.

The genus *Chordaria* is so named from the plants which are included in it having exactly the appearance of dark-coloured strings or bundles of twine. Fig. 70 represents the well-known species *Chordaria flagelliformis* the scourge or whip-like Chordaria. This plant is a summer annual, and grows in rock pools between tide marks. The fronds are from a few inches to 2ft. or 3ft. long, having a central stem for about half the length of the plant, the upper part being irregularly divided or branched, the lower portion bearing here and there on each side, short ramuli, mostly of the same thickness and consistency as the stem and branches of the plant. In

the living state the fronds of this species are soft and slimy to the touch, a character which is due to the numerous colourless fibres which clothe the whole surface of the frond. The spores are concealed among the filaments of which the external layer of the plant is composed. *C. divaricata* is much more rare. Belfast Lough, and the shore at Carrickfergus, being hitherto the only recorded British habitats. I have, however, taken it at Plymouth, at Shanklin in the Isle of Wight, and in rock pools in the Cumbrae Islands; in the latter it was growing in society with *C. flagelliformis*, to which it bears a strong resemblance although it is much more branched and bushy. The branches spread in all directions, and are very irregularly

FIG. 70. *Chordaria flagelliformis.*

divided. Many of the ramuli are very short, and some are curved, or stand out at right angles from the stem. Care should be observed in mounting these plants on paper not to employ too heavy pressure at first, otherwise the fronds are apt to adhere to the linen so firmly that they tear away on its removal.

The genus *Mesogloia* contains three species, which in the living state are certainly not very attractive plants, having more the appearance of bundles of brown or dark greenish slimy worms than any vegetable production. Portions of them, however, when submitted to microscopic examination, exhibit a remarkably beautiful arrangement of cellular structure. The

axis or central portion of the stem is composed of elongated interlacing fibres, imbedded in gelatine; the outer margin is made up of horizontal or radiating tufted branching filaments, among which the dark olive coloured spores are produced. The name is from the Greek for "middle" and "viscid," in reference to the viscid or glutinous nature of the axis. *Mesogloia vermicularis* is the common species found all round our coasts. It grows on rocks and in tide pools, and is sometimes cast ashore of large size. The fronds are irregularly and usually much branched, being set with numerous ramuli, all of which, like the stem and main branches of the plant, are flaccid and slimy, and singularly worm-like, hence the specific name. The colour is a dark yellowish olive, which it generally retains in drying. *M. virescens*, a main branch of which is represented at Fig. 71, is, in many respects, similar to the former species, but may be known by its much lighter colour, which inclines more to a green than an olive tint, especially in drying, when it invariably turns to a pale yellowish green. These curious plants are very variable in size. The former sometimes attains a length of 2ft, but the latter I have never known to exceed 12in. or 15in. The species *M. Griffithsiana* is rare. It was named after the late Mrs. Griffiths, of Torquay, who discovered it. The fronds rarely exceed a foot in height, and are much more slender and less copiously branched than the two species already described. It is said to be found on the West of Ireland, and although it is decidedly rare on the English shores, I have taken several beautiful specimens near Plymouth, on different occasions. All the species of *Mesogloia*, when displayed on paper, must be allowed to dry for several hours before the slightest pressure is attempted.

At the head of the fleshy or cartilaginous seaweeds is placed the curious plant known as *Leathesia tuberiformis* (Fig. 72), named in honour of Rev. Mr. Leathes, an eminent naturalist. This singular marine production has exactly the appearance of a mass of distorted tubers variously heaped together, suggesting the not inappropriate name of "sea potatoes." In early growth the roundish lobes of this alga are solid, or filled with densely-packed cotton-like fibres, but as they advance in growth they become hollow and break away from the rocks or seaweeds on which they grow. The structure of this tuberous mass is very remarkable, but it would require a large series of diagrams to illustrate a description of its composition. The illustration gives a good general idea of its form as it is found in various stages of growth on rocks or attached to other seaweeds. *L. crispa* is a small and somewhat insignificant species, parasitic on *Chondrus crispus*. It was discovered not many years since by a naturalist in Scotland. *L. Berkeleyi*, though not so abundant as the type of this genus, is not uncommon, but being of a dark brownish olive, and growing close to the surface of submarine rocks, it frequently escapes notice, or when found is too often rejected on account of its generally unattractive appearance. When specimens of these fleshy plants are desired for the herbarium, portions of the young plants should be selected, and after being cleaned from sand or other foreign matter, the mass should be placed on mounting

FIG. 71. A main branch of *Mesogloia virescens*.

FIG. 72. *Leathesia tuberiformis* in various stages of growth, attached to a stunted red seaweed.

paper and allowed to dry or shrink a little; then upon immersing it in sea-water again, and afterwards draining away the water, it may be treated in the ordinary way, always bearing in mind that pressure for fleshy as well as gelatinous plants, must be gradually and carefully applied.

The genus *Ralfsia*, named in honour of John Ralfs, Esq., of Penzance, contains one species only, *Ralfsia verrucosa*, the frond of which is of a leathery or crustaceous nature. It is attached by its under surface to the flat rocks which occur in some situations between tide-marks. The colour of this leathery-like plant is a dull brown. The fruit is contained in dwarf-like prominences, which appear on the surface of the plant, scattered here and there among the concentric zone-like markings of the fronds.

FIG. 73 (*a*) *Elachista fucicola* on *Fucus vesiculosus*; (*b*) branched filament with spore, highly magnified.

The genus *Elachista*—from the Greek, signifying "the least," in reference to the small size of these plants—contains several species, all of which, with the exception of one, are more interesting as objects for microscopic examination than as specimens for ordinary collections. The largest and commonest of these tiny plants is the species *Elachista fucicola* (Fig. 73), which is found constantly parasitical near the terminal branches of *Fucus vesiculosus* (Fig. 37). Four tufts of this parasite are represented growing on the *Fucus* (*a*), and under it (*b*) a branch of the club-headed jointed filaments which arise from the tubercular base, among which the pear-shaped spores of these minute plants are produced. The tufts of this *Elachista* are rarely more than an inch long, and are of a dark olive colour. *E. pulvinata*, or *attenuata*, is parasitical on *Cystoseira ericoides*. Fig. 74 represents a terminal branch of the *Cystoseira*, on which are growing several little globular or cushion-life tufts of this minute parasite. An examination of this figure, which was carefully taken from the living plant, will help students to recognise this species, as well as to give them a general idea of the appearance and manner of growth of other species of *Elachistæ*. *E. stellulata*, a minute star-like plant, parasitic on *Dictyota dichotoma*

(Fig. 61) is represented at *a*, Fig. 75, highly magnified, on a portion of the frond of the *Dictyota*. Under the microscope this is a very beautiful object. The delicate little filaments radiate from the basal tubercle, and among these, for about half their length, are inserted *paranemata*, or false filaments, at the base of which the spores are seated. *E. flaccida* occurs in little tufts about half an inch long, on *Cystoseira fibrosa* (Fig. 41). *E. scutulata* in oblong wart-like masses about 1in. in length, on the thongs of *Himanthalia* (Fig. 42); and sometimes in society with it, in little velvety patches, the minute species known as *E. velutina*.

The genus which I am about to describe consists entirely of minute parasites, several of which require the microscope even to detect them. And here, again, I once more direct my readers' attention to the necessity for acquiring a knowledge of microscopic manipulation.

FIG. 74. *Elachista attenuata* on *Cystoseira ericoides*.

An examination of the tiny plants which are included in the genus *Myrionema* will amply reward the student for any amount of trouble he may incur in preparing these parasitic algæ for the various powers of the microscope. As these plants are usually in perfection when the various species on which they grow are in a state of decay, I recommend collectors to search for them in early autumn rather than during spring and summer. Those which are constant on such plants as the *Ulvæ* and *Enteromorphæ*, for instance, are much more easily detected when the fronds of those bright green plants are bleached or faded, than when they are in perfection. The name *Myrionema* is from the Greek, signifying "multitudinous threads," in reference to the numerous thread-like unbranched filaments of which these little seaweeds all consist. Fig. 75, *b*, represents the species *Myrionema strangulans*, several ring-like masses of which encircle the branch of a frond of *Enteromorpha compressa* (Fig. 8). It is found also on the decaying fronds of *Ulva lattissima* (Fig. 5), and on them it appears like a number of little brownish spots, scattered over the surface of the plant sometimes abundantly. *M. punctiforme* is, at maturity, a little globular dot, or rosette, composed of tiny radiating filaments, parasitical on *Ceramium rubrum*, as represented at *c*, Fig. 75. It is found also on some other red weeds, and on whatever species it does occur, it generally

infests, at short intervals, every portion of the plant. *M. Leclancherii* is found on faded fronds of the common *Rhodymenia palmata*, and the extremely minute species, *M. clavatum*, occurs only on the plant known as *Hildenbrantia rubra*, a purplish-red crustaceous alga, which spreads over the surface of stones, and the sides of rock pools, about half-tide level.

The plants included in the order *Ectocarpaceæ*, are briefly characterised as olive-coloured, jointed, filiform, or string-like seaweeds, whose spores are, for the most part, produced externally, attached to jointed ramuli or branchlets. The name of this order is derived from the genus *Ectocarpus*, which signifies external or exposed fruit, the fructification of all the species of *Ectocarpus* being more or less exposed or conspicuous. To those collectors who desire an accurate knowledge of specific distinction in this

FIG. 75. (*a*) *Elachista stellulata* on *Dictyota dichotoma*. (*b*) *Myrionema strangulans* on *Enteromorpha compressa*. (*c*) *Myrionema punctiforme* on *Ceramium rubrum*. All more or less magnified.

genus, a microscopic examination of the fruit of these plants will prove at once interesting and instructive. To the unassisted eye many of the *Ectocarpaceæ* are wonderfully alike, but plants in fruit quickly declare themselves even under an ordinary lens, and when once a true species is secured and studied, subsequent identification, even in barren specimens of the same species, is thus rendered far less difficult. Many of the common species of this order are very widely dispersed. The beautiful species *Mertensii* is as plentiful on some of the Scottish shores as on the south Devonshire coast, where, especially around Plymouth, this lovely plant is taken in great perfection.

Some of the *Sphacelarieæ*, too, are alike plentiful in the north and south of this country. *Sphacelaria filicina*, one of the most delicate and beautiful of the filamentous melanosperms, is found on the north and south coast of Devon, in the Channel Islands, and in the Mediterranean; and, in fact, there are no continental generic forms of this order known (as observed by Dr. Harvey) which are not represented in our marine flora. None of the plants of this order are gelatinous; on the contrary, many of them are rigid and adhere very imperfectly to paper. This is especially the case with the genera *Cladostephus* and *Sphacelaria*, but all the others are very manageable, and may be pressed so flat and close to the surface of the paper, as to present the appearance of the most exquisite engravings, rather than copiously branched and jointed vegetable productions.

The genus *Cladostephus* is represented on our shores by two common and very easily-recognised species. *C. verticillatus* (Fig. 76) is found in rock pools, on corallines, or growing in exposed situations, often in large bushy tufts from 3in. to 10in. high, the stems and branches of which are stiff and wiry, and are set throughout at close and regular intervals with whorls of little ramuli (*b*), all of which are incurved near the tips. These whorled branchlets are furnished irregularly with one or two shorter ramuli, which point outwards and upwards, forming, in fact, a series of little crowns, whence the name of the genus, that of *Cladostephus*, or "branch of crowns," and the regularity with which these crowns or whorls are set on the branches is expressed in the specific name of *verticillatus*. In winter these verticillate tufts fall off, and another irregularly disposed set of ramuli shoot forth, on the outward and upper side of which little elliptical spores are produced, seated on pedicels or short stalks. *C. spongiosus*, so called from the thick or spongy nature of the branches, which are very densely crowded with closely-set whorled ramuli, is common on most rocky shores. In some situations, where the tide leaves bare flat open spaces and overhanging ledges of rocks near low-water mark, this plant is often found in great abundance, spreading over the surface, or hanging from crevices in the rocks like large masses of black worsted. It is extremely difficult to display well on paper, and is by no means an attractive book specimen. The fruit is produced during winter in a similar manner to that of the preceding species.

The genus *Sphacelaria*, from the Greek for gangrene, in reference to the withered or decayed tips of the fruitful branches, contains several very beautiful plants; some are of large size, and others are strictly microscopic. They are all distinguished by the extreme rigidity of their stems and branches, several species being of exquisite symmetry, simulating the form and ramification of the most delicate exotic ferns. This is especially the case with regard to the species *Sphacelaria filicina*, branches of which are represented at Fig. 77. This charming plant is generally considered to be one of the most beautiful of the British marine algæ. The plant represented in the illustration was taken near Ilfracombe, but this species

FIG. 76. (*a*) *Cladostephus verticillatus.* (*b*) Magnified portion of same.

FIG. 77. *Sphacelaria filicina.*

is more frequently met with eastward of Plymouth Breakwater, where I have occasionally dredged it of large size, but in no instance have I ever detected fruit. The very curious and minute species known as *S. sertularia*, is parasitical on algæ which grow in deep water. It is rarely met with, perhaps on account of its small size and the depths in which it loves to vegetate. Dr. Harvey considers it to be merely a deep water variety of the foregoing species. It is a very much smaller plant, and the branches and ramuli are shorter and generally spread out at right angles with the stem. *S. scoparia* is a large coarsely branching plant found in most seas; on the southern shores of the Isle of Wight its large tufted fronds frequently strew the beach in great abundance. The summer and winter conditions of this species are widely different. In early growth, and during the summer its tufted branches are thick and bushy, resembling little brooms, but at the close of the season its superabundant branches and

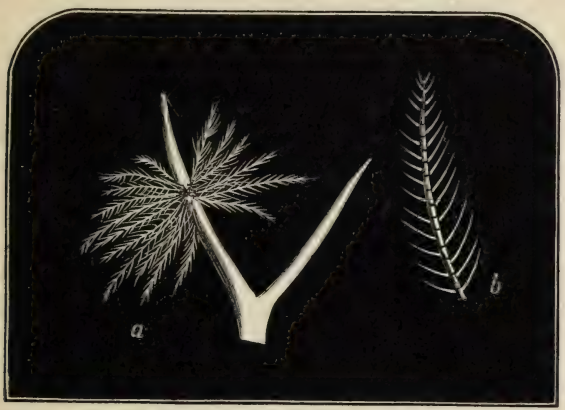


FIG. 78. (*a*) Terminal branch of a seaweed, with a tuft of *Sphacelaria cirrhosa*. (*b*) Plume from the same, magnified.

ramuli fall away, totally changing its character, specimens of which bear occasionally such a striking resemblance to loosely branching forms of *S. filicina*, that many an inexperienced botanist has been deceived as to its identity. Fig. 78 (*a*) represents one of the varieties or forms of the species *S. cirrhosa*, parasitical on a terminal fork of a seaweed, and beside it (*b*) one of the plumes of which this pretty little plant consists. In some varieties of this species the filaments form little star-like tufts, as in the illustration; in others the tufts are globular in form and densely branched. I took this variety many years ago in great plenty, as it was floated in by the tide on the shore of the Great Cumbrae Island. Every specimen I picked up on that occasion was in fruit. The spores are like little round balls seated near the base of the branchlets, generally one or two, opposite or sometimes close together. Another very tiny variety of this plant I have taken

abundantly at Largs, on the Clyde, parasitic on the stems of *Desmarestia aculeata* (Fig. 53). *S. radicans* grows on sand-covered rocks, in small tufts rarely exceeding an inch in height. *S. fusca* is a rarity, though it was discovered as long ago as the year 1827. It may be known by a very peculiar form of ramuli which are borne on some of the filaments near the tips. Dr. Harvey describes them as being "attenuated at the base and trifid at the apex, the joints of the plant being marked with a pale brown band." The specific name is from the reddish-brown colour of the plant. *S. racemosa*, so named from the clusters of grape-like spores produced on each side of the filaments, was discovered by Sir John Richardson in 1821, on the shores of the Frith of Forth. For very many years this curious plant eluded the search of algologists in all parts of this kingdom, and indeed was generally regarded as a lost species, when all at once, a few years since, it was discovered in tolerable plenty, in the river Clyde, by Mr. Roger Hennedy. This rare plant I have never met with, and know it only by Dr. Harvey's beautiful figures in his "Phycologia." *S. plumosa* (Fig. 79) is, so far as my experience goes, peculiarly an inhabitant of northern waters, and even there it is regarded as a rarity. It is said to be found at Greenland and in the Arctic regions, while the coast of Cornwall is given as its southern limit. About twelve years ago I took a beautiful specimen of this plant in the bay of Lamlash. It was attached to a large stone that came up in the dredge from a depth of five-and-twenty fathoms. The branches of this species very closely resemble feathers, being regularly pinnated with opposite, spreading, generally unbranched pinnæ or winglets, the tips of which are frequently sphacelate or withered. I have described this rare and peculiar plant as among the *Sphacelarieæ*, but I must inform my readers that Professor Agardh, the celebrated Swedish algologist, has removed it from this order, and erected it into the type of a new one under the name of *Chætopteris*, which signifies "bristle wing," in reference to the erect bristle-like pinnæ or ramuli of its branches, the original specific and very characteristic name of *plumosa* being retained.

Advancing onwards with my description of the *Ectocarpaceæ*, I now arrive at the genus *Ectocarpus*, the simplest in point of structure and fructification of any of the plants of this order. In these the frond is composed of a single simple or highly-branched filament, and producing spores and active granules or zoospores in pod-like bodies, which are seated on the branches of some, or produced conspicuously in the stem or branches of other individuals. Many of these fruit-bearing organs afford most beautiful microscopic objects, as may be seen in the group of magnified portions at Fig. 80. The extreme difficulty of giving anything like a satisfactory representation of any living species of *Ectocarpus* obliges me to be content with a slightly magnified portion of one of the shore species, and to represent fertile branches of a few others much more highly magnified. Fig. 81 represents a lateral branch from a fine specimen of *E. littoralis*, a common species which is found abundantly on the shore *Fuci* at all seasons. The tufts are from 6in. to more than 12in. long, of a brownish-

FIG. 79. *Sphacelaria plumosa.*

FIG. 80. Magnified portions of *Ectocarpaceæ*—(*a*) *E. littoralis;* (*b*) *E. granulosus* ; (*c*) *E. brachiatus*; (*d*) *E. fenestratus*; (*e*) *E. Mertensii.*

olive colour, very much entangled and matted together, a character which is pretty general among the plants of this genus. The fruit is produced in oblong masses embedded in the central portion of the branches and ramuli, as represented at *a* (Fig. 80). *E. granulosus*, under even a moderate power, is a pretty and very distinctly marked species, all the branches and ramuli being for the most part exactly opposite, the little dark coloured elliptical spores being seated on the upper side of the spreading ramuli or branchlets, as seen at *b* (Fig. 80). This species is parasitical on several of the lesser algæ between tide-marks. *E. brachiatus* (*c*) is another well

FIG. 81. *Ectocarpus littoralis.*

marked species, usually parasitical on *Rhodymenia palmata*, but rare. The filaments are beautifully fine and feathery, excessively branched, all the branches and ramuli being generally opposite. The fruit, which is binate, or separated into two portions, is imbedded in the axils of two opposite ramuli or branchlets, just where the branches are quarternate or cross-branched in fact, whence the specific name of "brachiatus." In the living state the fruited branches of this species under the microscope are

extremely beautiful. The joints of the stem and branches are a fine olive green, and are distinctly marked, while the two-parted capsular fruit-vessel is of a reddish-brown, and is surrounded by a hyaline or transparent border, forming a pretty contrast to the olive green stem and branches of the plant. A fruited sprig is represented at *c* (Fig. 80). *E. fenestratus*, (*d*) so called from the peculiar lattice-like markings on the surface of the silicules, is a small and not very attractive species. I have taken it at Plymouth and Whitsand Bay. The tufts are about 3in. high, the filaments are very thread-like and sparingly branched, the ramuli few, distant, and usually alternate along the branches. The silicules, or fruit-vessels, when present, are abundant, and are stalked, being produced at irregular intervals on each side of the branches. These silicules are of a larger size than the fruit-vessels of any other species of *Ectocarpus*, and may be known at once by their shape, which is elliptical, but rather narrow at each end, and by the peculiar transverse and cross markings all over their surface, a character which has suggested the specific name of this plant. A portion of the stem, bearing two silicules, is represented at *d*. *E. Mertensii* (*e*), dedicated to Professor Mertens, of Bremen, is one of the most charming of its tribe. It was discovered at Yarmouth, in 1779, and, although it is widely distributed, it is generally considered a rare species. I have had fine specimens sent to me from Peterhead and other northern stations, but the plants taken by me at Plymouth exceed in size and beauty every other specimen I have seen hitherto. This beautiful plant is in perfection in May and June. It is found on muddy rocks at low-water mark. The main stems are from 5in. to about 10in. long; the branches are numerous, and are of unequal length, being set throughout with lesser branches, all of which are branched on the same principle, and every division of branches and branchlets is invariably opposite, a regularity of growth which gives to the plant a beautiful feathery appearance. The whole plant is abundantly furnished with short pointed ramuli, which are placed opposite to each other at very short distances, usually at the upper shoulder of every third joint, and it is about the centre of these ramuli that the large binate sporiferous mass is produced. The jointing of this species is beautifully distinct, as may be seen at *e* (Fig. 80), where also the two-parted spore-vessel is represented. The colour is a fine olive green, the substance is flaccid, and, like all these summer annuals, this plant adheres closely to paper in drying. Once only have I found this rare species in fruit, and that occurred among the specimens I received from Peterhead. This fruited plant was so small and poor in appearance that I discarded it from my collection; but taking it up subsequently, and observing something peculiar on one of its stunted branches, I submitted it to the microscope, and found to my great surprise, that my little scrubby despised plant was a treasure indeed, being abundantly in fruit. This was a lesson to me, which I here record for the benefit of young students, never to throw aside any mounted plant, however apparently insignificant, until it has been thoroughly examined under the microscope.

There are several other species of *Ectocarpus*, some of which are very rare, but a few of them must be described, through briefly. *E. Hincksiæ*, a rare and beautiful but small species, may be looked for on the large oarweeds. It was discovered by Miss Hincks, of Belfast (whose name it appropriately bears), near the Giant's Causeway. Fine specimens are to be found growing on the larger *Laminariæ* off St. Michael's Mount, Cornwall, and also at Plymouth. *E. tomentosus* grows in abundance on the rock *Fuci*; the filaments of the branches are extremely slender, and densely interwoven and matted together. *E. crinitus*, the filaments of which are more delicate than the finest hair, spread over the surface of muddy shores like fine fleeces of a light brownish olive, changing to a glossy green in drying. *E. pusillus*, a small species, parasitical on some of the *Polysiphoniæ*; *E. distortus* on *Zostera marina*; and *E. Landsburgii*, obtained only by dredging in deep water. *E. longifructus*, very similar to *E. littoralis* (Fig. 81), but having long attenuated silicules, which are very closely marked with transverse striæ. *E. sphærophorus*, a small plant parasitical on the beautiful *Ptilota elegans*, and some other small algæ. This species may be readily known by the form of its fruit vessels (which are spherical), being produced opposite to each other on the upper branches, singly or in pairs, and sometimes even in groups of fours, attached to the sides of the stems of the plant. *E. tessellatus*, an extremely rare plant, I have found only occasionally near Plymouth. The fruit vessel of this species is a remarkable object under the microscope. The whole of the surface is marked like a tessellated pavement, whence the specific name.

Young collectors will find at first almost as much difficulty in distinguishing species among this group of algæ as is often the case with the puzzling varieties of *Cladophoræ*. But, as I have already observed, the presence of fruit in the *Ectocarpeæ*, which is often abundantly produced, saves an infinity of trouble, and only requires a little practice with the microscope, or even a good ordinary lens, to identify most of the species of these delicate algæ. The *Cladophoræ*, it will be remembered, are all green, alike in the living state and after they are pressed and dried, while the *Ectocarpeæ*, although mostly of a greenish hue when they are mounted on paper, are all, while growing, either olive or a brownish-olive colour.

The genus *Myriotrichia*, from the Greek for "numberless hairs" (in reference to the multitudes of ramuli and fibres which clothe the stems of these minute parasitical plants), consists of two species, either or both of which are frequently met with where *Chorda lomentaria* (Fig. 44) and *Asperococcus echinatus* (Fig. 69) occur. These unattractive but curious plants are generally abundant during the summer months, parasitical chiefly on the constricted fronds of *Chorda lomentaria* (Fig. 44), encircling the long cylinders of this alga at intervals, and crowning the tips with a brush-like tuft of slender, twisted or entangled filaments. Fig. 82 represents the species *Myriotrichia filiformis*, somewhat magnified, attached to a frond of *Chorda lomentaria* (Fig. 44). Reference to the high powers

of the microscope is necessary to an appreciation of the growth and structure of these parasites. In the species before us, the filaments are like a bundle of curly strings which have been partly unravelled and tied loosely together at the base ; while in the species *M. clavæformis* the fronds, although equally produced in bundles, are attenuated at the base, and swell out into club-headed tips resembling a fox's brush. The former species is most frequent, though both are sometimes met with growing together on the fronds of the same seaweed. There is little or no difficulty in mounting these plants on paper, the fronds and ramuli being flaccid and

FIG. 82. *Myriotrichia filiformis* on *Chorda lomentaria*.

more or less gelatinous. But in order to display the species properly, and represent the parasitic growth satisfactorily to the eye of a botanist, the whole plant on which the parasite is growing should be secured and arranged on the paper while still floating in sea-water, so that the tender filaments of the parasite may spread out freely and lie in a natural position as the paper is raised gently from the water in a slanting direction. The water will thus drain away from the specimen gradually, otherwise the string-like filaments will clot together, and the whole process will have to be repeated. With this genus I close my description of the British Melanosperms.

SECTION III.

RHODOSPERMEÆ.

Red Seaweeds.

UNTIL so comparatively recent a period as the summer of 1857, the standard work on British Marine Algæ, both as regards systematic arrangement and nomenclature, was Professor Harvey's "Phycologia Britannica," in which magnificent publication the "rose-tangles," or red seaweeds, are described under the general title of *Rhodospermeæ*, or red-seeded plants. But since the completion of Professor Harvey's great work, a new arrangement of the Rhodosperms has been published by Professor Agardh, the Swedish algologist. This arrangement is based on a more accurately scientific investigation of the sporiferous nuclei, or spore-producing bodies, in the various species of this great subdivision. The Agardhian arrangement of the red seaweeds is divided into two series, the lesser organised families being included under the title *Gongylospermeæ*, or plants whose sporiferous nuclei contain numerous spores congregated without order in each nucleus or spore receptacle, and the more highly organised families classed under the title *Desmiospermeæ*, the sporiferous nuclei of these consisting of tufted spore threads or filaments, a single spore being formed in each cell of the tufted threads, or only in the terminal cell. Some portions even of this arrangement have been modified or altered, and the names of many species have been changed by Professor Agardh himself, and as I am convinced that all these recent changes have been the result of the most definite and accurate observation, it is my intention in describing the British Rhodosperms, to adopt Professor Agardh's arrangement, and most recent nomenclature; although, for my own convenience, particularly as regards the extreme difficulty of preparing many of the illustrations, I shall now and then be compelled to describe families, or at least *genera*, somewhat out of regular scientific order. However, to the general reader, and even to young algological students, this will make no difference whatever as to their acquisition of a knowledge of the plants themselves, which is indeed, after all, my primary object in writing this work.

Although, to ordinary observation, the most striking characteristic of the plants of this great subdivision is their colour, the scientific student finds a more remarkable and distinctive characteristic in the double system of fructification, nearly every genus being furnished with two different kinds of reproductive bodies, or spore-bearing organs, which are

produced on different individuals of the same species. A complete knowledge therefore of the system of fructification of the red plants includes that of two individuals of the same species, one of which exhibits what is termed the primary, or conceptacular, the other the secondary, or granular, form of fruit. The sporiferous nucleus is described as consisting of numerous articulated or jointed filaments in distinct and variously formed conceptacles or spore-vessels, the joints of which become fertile or are transformed into spores. In no instance do the spores of the algæ exhibit at any period of their development an approach to a rudimentary plant, as in the germinating seeds of the *Phanerogamia*, or flowering plants. They are found to consist entirely of a dense deep-red granular or starch-like matter, called "endochrome," enveloped in a nearly colourless skin or pericarp, consisting of two or three membranes. The secondary form of fruit consists of tetraspores or four-parted seeds. These are produced from a division of the endochrome of certain privileged cells, the spherical mass of which they consist being separated into four parts, three of which are so placed within the enveloping membrane that the fourth part is completely hidden beneath them. Some forms of the tetraspore are, however, arranged so that all the four parts are visible at once. This occurs by transverse division of the endochrome, and is called "zoned" or "annular"; when divided by cross-lines into four equal parts, the tetraspore is cruciate; and when the division is by triradiate lines, and the parts are of unequal size, it is said to be ternately parted. Both forms of fructification are alike capable of reproducing their species; the tetraspores are, however, now generally regarded as *gemmæ* or buds, and thus they may be said to extend the life of the individual, rather than to reproduce the species. In the primary form of fruit the spores are rendered fertile by contact with antherozoids, which are produced in variously formed yellow-tinted cases called "antheridia," found abundantly on plants in so many genera that they are doubtless developed in all, and always, of course, on plants which bear neither spores nor tetraspores. Further descriptions of the form and structure of the various fruit-bearing receptacles of the red plants will be given as each particular species is described and illustrated.

I shall commence with a description of the plants which are included in the great series *Desmiospermeæ*, and follow the order in which they are classed in Professor Agardh's most recent arrangement. Beginning, therefore, with the family *Rhodomelaceæ*, I shall describe the plants in the British genera which the Swedish professor includes in his order *Chondrieæ*, and these are *Polyides*, *Lomentaria*, *Laurencia*, and *Bonnemaisonia*. *Polyides rotundus*, now *Polyides lumbricalis* (Fig. 83), was formerly placed in the sub-order *Spongiocarpeæ*. On the southern British shores this is one of the common red weeds, being found in shallow rock pools between tide-marks in very great abundance. It is by no means a favourite species with ordinary collectors, being difficult to display effectively on paper, owing to its large disk-like root and its numerous forked, thick round

FIG. 83. *Polyides lumbricalis.*

FIG. 84. *Lomentaria kaliformis.*

branches, all of which spread out and point upwards, and when well mounted on paper may be made to describe a complete circle. The fructification of this curious plant constitutes its chief interest, at least to an algologist. Tetraspores are found occasionally immersed among the filaments of the periphery or outer margin of the frond; but it is the primary form of fruit that has caused this species to receive more than ordinary attention, and has given British and foreign systematists a world of trouble. The illustration, Fig. 83, represents a large frond of *Polyides lumbricalis*, taken by me at Whitsand Bay, near Plymouth; the branches are crowded with dark brown-red spongy or wart-like masses of a roundish or oblong form. These warty masses are called "favellæ," and contain clusters of spores imbedded in their substance, each cluster being surrounded by a pellucid or colourless border.

I now pass on to the plants which are included in Professor Agardh's newly-constituted genus *Lomentaria*; the name having reference to the cross lines, or constrictions, which occur throughout the stems and branches of these plants. The fronds of most of the species of this group may be briefly described as being, for the most part, tubular, constricted, or tied in, as it were, at short intervals, and filled with a slimy or watery juice, which last peculiarity was referred to in the original name of this genus, viz:—*Chylocladia* or "juicy branch." The spores of these plants are contained in round, or sometimes conical, conceptacles, called "ceramidia;" tripartite tetraspores are imbedded in the branches and ramuli. *Lomentaria kaliformis*, represented at Fig. 84, by the terminal portion of a branch, is a summer annual, being found from June to September. It varies greatly in size according to its place of growth. Plants which are found in tidal rock pools are stunted in form and poor in colour, but specimens which are dredged, or are cast ashore, exhibit the normal form of this handsome species in perfection, the fronds being from 12in. to 20in. long, and of a fine purple-red colour. The capsules of this species are spherical and very distinct, being of tolerably large size, and are seated on the young branches. Tetraspores are immersed in the ramuli, and may be seen easily with an ordinary lens. Large specimens of this plant are troublesome to mount on paper, on account of the densely-packed whorls of branchlets and ramuli, which are set around the stems with tolerable regularity at the numerous constrictions, many of the whorls bearing one or more series of lesser branches and ramuli, all of which taper by degrees as they approach the tips. A little judicious pruning, however, helps to form beautiful specimens for the herbarium, but great care must be observed in the pressure employed, which must be very gradual; indeed, this remark applies to all of these juicy-branched plants, many of which should be allowed to drain and contract under the calico and blotting paper before they are subjected to any degree of pressure. *L. ovalis* (Fig. 85) is abundant on the north and south coast of Devon. This curious plant, with its little tufts of bud-like ramuli, produced irregularly on the stems and branches, has somewhat

the appearance of a shrub putting forth its spring leaflets. In early growth these little leafy ramuli are nearly oval in form, but as the plant advances in growth the ramuli lengthen, and even occasionally taper at the apex, which, in most instances, is obtuse or rounded, the bases being always attenuated and sometimes even slightly stalked. Globular capsules are produced on each side of these ramuli ; tetraspores are immersed within them. *L. articulata* (Fig. 86), formerly, and until very lately, *Chylocladia articulata*, is one of the most abundant of its tribe, being found under the shelter of large over-hanging weeds, on rocks, and in tide pools, clinging to the surfaces by means of its fibrous roots, like a beautiful crimson fleece. This, however, is the stunted form of the species. This plant is taken in perfection during the summer months only, by means of

FIG. 85. *Lomentaria ovalis.*

the dredge; though occasionally it is thrown up from deep water. Such specimens are deservedly very much admired. The illustration represents a luxuriant form of one of these. They are sometimes above 12in. long, and are excessively branched ; the stems and branches throughout being constricted at regular intervals, composed in fact of chains of elliptical bead-like joints, and here and there, from the articulations of the upper branches, spring whorls of similarly constricted ramuli, the beaded joints of which are much shorter and the tips usually pointing upwards ; the whole plant when spread out having generally a beautifully rounded outline. Spores are contained in conical capsules; tetraspores in the elliptical joints of the ramuli. *L. parvula*, formerly *Chylocladia parvula*, then removed by Dr. Harvey to the genus *Champia*, and recently placed by Agardh in the genus

FIG. 86. *Lomentaria articulata.*

FIG. 87. *Lomentaria parvula.*

Lomentaria, is a summer annual, by no means abundant on our shores, though very common on the American coasts. It is easily distinguished from the others of its tribe by the much shorter joints of its stems and branches, all of which are of nearly equal length and breadth, those in the ramuli being proportionally shorter, and the tips of the branches and ramuli obtuse or rounded; capsules, which are ovate or egg-shaped, are produced on the branchlets; tetraspores in the joints. Fig. 87 represents a branch or two of this species. *L. reflexa* is the rarity of this genus. I have take it but once only, and that was during a dredging excursion at Plymouth, when it came up in the dredge attached by little root-like processes to a fragment of another alga. This species is very sparingly branched; the branches being mostly what is termed "secund," or produced on one side only of the stems. The ramuli spread out widely, or are curved slightly downwards, hence the specific name *reflexa*.

FIG. 88. *Laurencia pinnatifida.*

The genus *Laurencia*, as recently revised by Professor Agardh, contains only three British species, all of which are more or less common; one, *L. pinnatifida*, being found in all seas, and is equally abundant in temperate and tropical climates. On our own shores this species is very common; and indeed, it is so extremely variable in size and general appearance, as well as colour, according to the depth of water in which it grows, that botanists recognise and describe no less than three varieties. The typical form of this species, as represented in Fig. 88, rarely grows above extreme low-water mark; but in this situation and in deeper water it attains a length of 12in. or more, and is of a fine dark purple, or sometimes brown-red. As this species advances towards the shore it becomes stunted in form and size, though still preserving its characteristic appearance,

save in colour, which, on high exposed rocks retains no shade of red or purple; being of a dirty brownish olive, sometimes even green, or a dull yellow; and when cast ashore is generally bleached white. The substance of this plant is firm and leathery, and although the branches are mostly flat and pretty regularly disposed, they require to be pruned here and there before they are submitted to pressure. Well-grown plants of this species, with requisite care in mounting, form beautiful specimens for the herbarium. *L. pinnatifida* has a strong pungent taste, and in Scotland, where it is eaten, it is commonly known as "pepper-dulse." The spores of this plant are contained in broad ovate capsules which are seated on each side of the branchlets, tetraspores are embedded in the ramuli. *L. hybrida* (Agardh), formerly *L. cæspitosa*, or the tufted Laurencia, is found on stones, and in shallow rock pools between tide-marks. This species rarely attains the size of the foregoing; its branches are shorter and more bushy, and all the divisions of the plant are more or less cylindrical, being rarely compressed or flattened, as in *L. pinnatifida*. The ramuli are generally very much crowded, spreading on all sides of the branches, tapering towards the base, and truncated at the tips. The colour varies from a dark olive to a pale greenish yellow, and occasionally, in shady situations, attaining a lurid purple tint. Some writers consider this plant to be merely a shore variety of *L. pinnatifida* (Fig. 88), or, at most, as intermediate between it and *L. obtusa*, two branchlets of which are represented at Fig. 89. One bears ovate ceramidia, the other tetraspores, which are immersed without order near the tips of the ramuli. This species is a summer annual, and is most abundant on the southern shores of England. It grows on the *Fuci*, but is generally found cast ashore. Mature plants, when properly displayed, form elegant specimens for the herbarium, being of a fine pink or rose-red, and having a beautiful pyramidal outline. The stems and branches are pretty nearly of a similar thickness throughout; the branches and ramuli are mostly opposite; and all the terminal divisions are truncate or obtuse, whence the specific name.

The elegant plant which is represented by a few branches at Fig. 90 is, as Dr. Harvey has observed, "one of the most distinctly marked species of its tribe, and so unlike any other British alga, that it must be recognised at a glance." The delicate cilia, or spine-like ramuli, which border every part of the frond, and which are arranged with strict regularity, being placed alternate to each other, and opposite either to a capsule or to a branch, afford marks that cannot be mistaken. The generic name, *Bonnemaisonia*, is in honour of Mons. Bonnemaison, a French naturalist; the specific, that of *asparagoides*, is very appropriate, its resemblance to the mature asparagus plant being very striking. This beautiful annual is a deep-water plant. It is often cast ashore on the South Devonshire coast, particularly in the neighbourhood of Plymouth, but my finest specimens were dredged in Lamlash Bay, Isle of Arran. The colour is a brilliant crimson, the substance is soft and delicate, and the fronds being

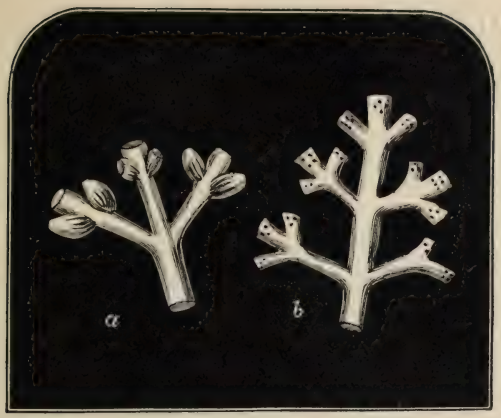


FIG. 89. Terminal sprigs of *Laurencia obtusa*, showing the capsular and granular fructification magnified.

FIG. 90. *Bonnemaisonia asparagoides.*

compressed or flattened, are easy to display on paper, to which they closely adhere in drying.

Chondriopsis dasyphylla and *C. tenuissima* were formerly included in the genus *Laurencia*, under the name of *L. dasyphylla* and *L. tenuissima*, whence they were removed into the more recently formed genus *Chondria*, and now they stand at the head of Professor Agardh's most recently rearranged order *Rhodomelaceæ*. Professor Agardh divides his Orders into tribes, genera, and species. Tribe 1, in his Order, *Rhodomelaceæ*, is termed *Chondriopsideæ*, and the genus *Chondriopsis* is represented in Britain by the two species *C. dasyphylla* and *C. tenuissima*.

FIG. 91. (*a*) *Chondriopsis dasyphylla*; (*b*) Magnified branchlet, with ceramidia.

Fig. 91. represents a branch or two of the former species, with a magnified portion bearing ovate capsules, which are seated on the inner sides of the branchlets. When tetraspores are present, they are produced here and there in the ramuli. This summer annual is found pretty generally on the English and Irish shores, usually between tide-marks, or cast up from deep water. The fronds are from 6in. to 12in. high, the stems generally undivided and set throughout on each side with branches, which lengthen towards the base of the main stems; the lower branches usually bearing a second series, all of which are set here and there with short ramuli, which are attenuated towards the base, and are club-shaped or

obtuse at the tips, the frond throughout being marked at pretty regular intervals with distinct transverse lines, as indicated in the magnified branchlet in Fig. 91 (*b*). The colour of the living plant is a light pink, the stems inclining to pale yellow; but this species being of a rather gelatinous nature, decomposes quickly, and therefore no time should be lost in transferring it to paper. This liability to fade and decompose is even more characteristic of the species *C. tenuissima*, a rare summer annual which I have taken in perfection at Bovisand near Plymouth, and occasionally at Brighton. The growth and general appearance of this plant bear some resemblance to the foregoing, but it may be distinguished from that species at once, as well as from *Laurencia obtusa* (Fig. 89), which it also somewhat resembles, by its long slender ramuli, which are attenuated at both ends, many of them being tapered at the tips to a needle-like point.

C. tenuissima is represented at Fig. 92, by a magnified branchlet, bearing several ovate ceramidia; the tetraspores are always produced throughout the whole length of the long bristle-like ramuli. The colours of this species have all the fugitive characters of those of *C. dasyphylla*, though occasionally I have mounted young specimens, in which the lateral branches and ramuli were a delicate purple, and the stems a fine primrose or chrome yellow.

Tribe 2, has no British representative, but Tribe 3, contains three beautiful genera, the first of which is represented on our shores and in brackish streams by the curious species *Bostrichia scorpioides* (Fig. 93), both names being equally characteristic of the little curled or involute tips of the branches and some of the ramuli. I have taken this plant in the neighbourhood of Plymouth, but nowhere else. The fruit I have never seen, and I am not aware that it has ever been detected on British specimens. This species belongs to a group of very curious little plants, some of which are found in the tropics, others in the antarctic regions, and all are remarkable, according to Dr. Harvey, for their amphibious habits. A portion of one of my Plymouth specimens is represented at Fig. 93.

The genus *Rhodomela*, signifying "red and black," (because the plants of this group, though a fine brown-red, turn black in drying), contains two British species. *R. lycopodioides*, is peculiarly a northern species, being found most abundantly on the shores of Scotland, on the north-east coast of England, and in the north of Ireland; on the English shores I have never taken this species further south than the rock pools above Tynemouth, where, in the spring, the beautiful red lateral branches of this plant are thrown out on each side of the stems throughout the whole frond. These tufted branches are so closely beset with multifid ramuli, that when they are mounted on paper they bear a fanciful resemblance to a wolf's foot, whence the specific name. Fig. 94 is from a long branch of this species. The capsules containing spores are produced on the tufted ramuli, tetraspores are immersed in the branchlets. *R. subfusca* is common on the southern shores. The summer and winter

Fig. 92. Branch of *Chondriopsis tenuissima*, bearing ceramidia, magnified.

Fig. 93. *Bostrichia scorpioides.*

states of this species are widely different. This plant, like the foregoing, is perennial. As winter approaches, the tufted branches which clothe the fronds throughout, fall away, leaving the stems of the plant rigid and bare; but, on the return of spring, a series of beautiful tufts of pencilled filaments, or ramuli, shoot forth from the branches, and on these, little berry-like capsules are produced. The summer tetraspores are contained in winged branchlets; those which appear in winter are produced in curious tufted pods called *Stichidia*, as represented, highly magnified, at Fig. 95.

FIG. 94. *Rhodomela lycopodioides.*

Odonthalia dentata, or "toothed sea-branch," is another of our northern species of algæ, and one so distinctly marked that there is no possibility of mistaking it for anything else. It is abundant in Scotland, in the north of Ireland, and in the Isle of Man. I have taken it very frequently near that well-known fishing station called Cullercoats, north of the Tyne, but I have never had the good fortune to meet with a fruited specimen.

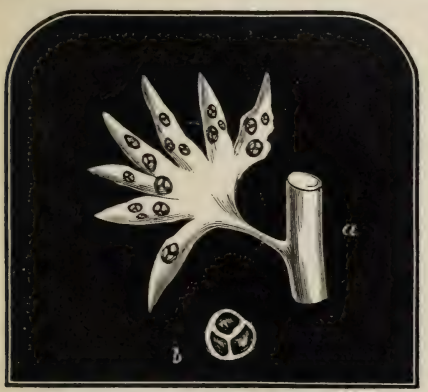


FIG. 95. (*a*) *Stichidia* with tetraspores of *Rhodomela subfusca*. (*b*) Tetraspore magnified.

The fructification of this species is curious and beautiful. Ceramidia are produced from the axils of the branches in tufts on a delicate little pedicel or stalk, and in the same situations, on other individuals, lanceolate pods or stichidia, also tufted and stalked, contain a double row of tetraspores, forming a most beautiful microscopic object.

Fig. 96 represents a branch of *Odonthalia*, and beside it is a tuft of the pretty bell-shaped ceramidia, containing spores. The colour of

this plant is a full blood-red, the older portions turning black in drying.

Tribe 4, *Polysiphonieæ*, contains the beautiful and extensive genus *Polysiphonia*, as well as the genus *Rytiphlœa*. In fact, three species of the latter are now included by Professor Agardh in his genus *Polysiphonia*, the number of species in *Rytiphlœa* being thus reduced, at least in Britain, to the well-known species, *Rytiphlœa pinastroides*, which I will first describe. This common plant is found pretty frequently on the southern shores of England growing in rock-pools, in densely branched bushy tufts from 4in. to 10in. high, spreading out on all sides, the branches throwing off a second and third series near the upper portions, and all the divisions being set, chiefly on one side of the branches, with short ramuli, which are hooked at the tips, or curved inwards; and on these, during winter, small roundish capsules are produced, seated usually on the inner sides. Tetraspores, on distinct plants, are imbedded in these incurved ramuli. The whole frond of this species is marked with distinct transverse lines, which can only be seen when the plant is gathered fresh from the sea, as it always turns black in drying.

Fig. 97 represents a terminal branch of *Rytiphlœa pinastroides*, magnified, showing the transverse striæ and ceramidia. The fronds of this species are extremely difficult to mount on paper, being rigid, and of a cartilaginous substance. My own plan is to display and press those portions which I care to retain, in the usual manner, and when the whole is tolerably dry, to immerse the specimen in skimmed milk for a quarter of an hour, and then dry and press as before; when, in the course of a day or two, upon removing the blotters and calico, the plant will be found firmly attached to the paper.

In describing the three transferred species of *Rytiphlœa*, I must confess some regret at their removal from the genus, for the external appearance, at least, of their stems and branches was certainly characteristic of the old name, which signifies "wrinkled bark," the peripheric, or external layer of cells, being small and numerous, giving to the surface of the plant when dry, a transversely wrinkled appearance; but the inner structure of the plants, and their fructification, are clearly those of *Polysiphonia*, hence their removal to that genus. However, before I enter on a description of that extensive and beautiful tribe of plants, I will dispose of the three species which have hitherto been included in *Rytiphlœa*. Fig. 98 represents a branch of the very rare *R. complanata*. I have never taken this species in any other locality than Cawsand Bay, near Plymouth. Possibly its extreme rarity may be due to the fact that fruit on this species is of very rare occurrence; indeed, when Dr. Harvey described this plant about five and twenty years ago, giving the south of England and the west of Ireland as its then known habitats, he remarked "that the fruit of this species had not been found in Britain." The colour of this pretty species is a dark brown-red, turning blackish in drying. In freshly gathered specimens, and before decomposition has set in, the frond is seen to be

FIG. 96. (*a*) *Odonthalia dentata*. (*b*) Bell-shaped *ceramidia*.

FIG. 97. Terminal branchlets of *Rytiphlœa pinastroides*—capsules on the ramuli.

FIG. 98. *Rytiphlœa complanata*.

beautifully reticulated, and marked at short distances by transverse striæ or slightly curved cross-lines, thus indicating the structure of the jointed or chambered internal axis, which is clearly visible with the aid of a good lens. This plant does not readily adhere to paper, but if it be soaked in fresh water for some hours, and afterwards subjected to strong pressure, careful manipulation will thus be rewarded with a beautiful book specimen. *R. thuyoides*, though not rare, is by no means common, though it is found in rocky tidepools in some situations in large quantities. I have occasionally found it thus in rock-pools under Mount Edgcumbe. Like the foregoing,

Fig. 99. *Rytiphlœa fruticulosa.*

it is a small species, being rarely over 4in. high. The colour is dark brown, sometimes even a yellowish olive, but turning nearly black in drying. This species is intermediate between the foregoing and *R. fruticulosa*. Fig. 99 represents a branch of this latter highly beautiful species. The plant from which it was taken was gathered by me off the rocks at extreme low water-mark in Whitsand Bay, where it grows abundantly and in high perfection. The colour of this plant in the growing state is another instance of the departure from the ordinary characteristic tint of the Rhodosperms, being usually a true purple, changing to a greenish tint,

and, under the influence of sunlight, becoming an amber yellow or pale straw colour. The fronds are sometimes from 6in. to 10in. high, very much branched, and set with numerous more or less tufted multifid ramuli. These ramuli are frequently tipped with antheridia, which are often produced so abundantly as to impart a prevailing yellow tint to the whole plant. Both forms of fructification are very well represented at Fig. 100: *a* is a branchlet, producing several little capsules, seated here and there on the sides of the twig-like branches; *b* is a branched ramulus containing tetraspores in the swollen or distorted articulations.

The beautiful and extensive genus *Polysiphonia* is represented by some of its species in all seas, from the poles to the equator. According to some writers there are upwards of 200 species of these plants known to botanists, some five or six-and-twenty of which are found on various parts of the British coasts. They vary greatly in size, in habit, and in colour; some being nearly 2ft. in length, and others barely 2in. high. Several species, when fully grown, are robust, bushy, and tree-like, while others are of extreme delicacy, the branches being finer than the finest human hair, resembling the most delicate exotic ferns in miniature. In colour they vary from a brilliant crimson to different shades of brown, red, and purple, and occasionally even approach a blackish tint. The structure of their stems and branches is well expressed in the generic name, which signifies "many siphons," the stems of all containing four or more primary cells or siphons, those of simple structure having four primaries in each articulation or joint, while others have as many as twenty four. These siphons are arranged round a central cavity, exactly like the spokes of a wheel around the axle-tree, and the regularity with which these siphons occur as regards number, is generally, in the absence of fruit, a pretty sure guide for the identification of species. A transverse cutting of the stem of a *Polysiphonia* fresh from the sea, placed under the microscope, or upon a slip of glass, and held under a lens, will reveal the beautiful structure of these plants most satisfactorily. When viewed thus, the central tube of some species will be found to be empty, while in others it is filled with endochrome like that of the siphons around it; and in those species of a more complicated structure, the main stems are seen to be coated externally, with more or less numerous small cells, in addition to their primaries. All these characters are very well represented in Fig. 101.

The following are those species which are most commonly met with on the British shores. Fig. 102 represents some branches of the well-known *Polysiphonia nigrescens*, which is a very common plant found in rock pools in every situation where seaweeds grow, and, being perennial, is met with in all seasons; but the only specimens which are sufficiently attractive to the collector are those which are found in the spring, when the branches throw out their pretty tufts of fine red filaments. The nearer to low-water mark such specimens are taken the better, otherwise the stems and lower branches of this species, when dried, become perfectly black and opaque. The dark colour, or opacity, in the stems of this species

is, doubtless, due to the large number of siphons, which is generally twenty, and these being set so closely together, very naturally account

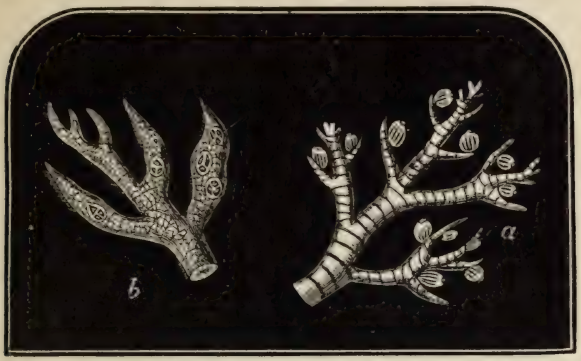


FIG. 100. Magnified branchlets of *Rytiphlœa fruticulosa*. (*a*) Capsules. (*b*) Tetraspores in the swollen ramuli.

for the dark tint of this species. A transverse section of the stem is seen at *a*, Fig. 101. *P. affinis*, usually regarded as a rarity, is a variety of *P. nigrescens*. The stem contains about sixteen siphons. The ceramidia,

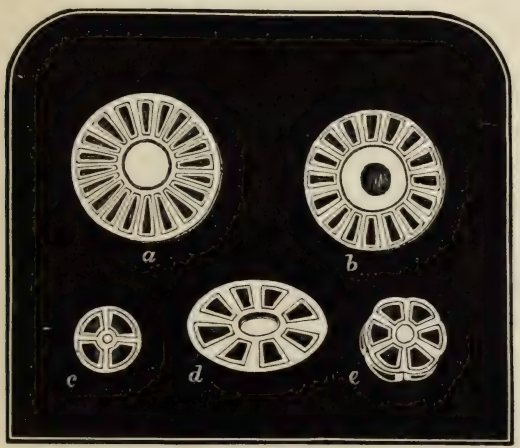


FIG. 101. (*a*) Transverse section of *Polysiphonia nigrescens*; (*b*) Ditto of *P. fastigiata*; (*c*) Ditto of *Polysiphonia fibrata*; (*d*) Ditto of *Polysiphonia parasitica*; (*e*) Ditto of *Polysiphonia variegata*.

or spore-vessels of *P. nigrescens* are ovate and sessile, or produced from the sides of the branches, but in *P. affinis*, they are nearly round, and

are seated on little stalks. *P. fibrata*, so named from the tufts of fibres which terminate the ramuli of every filament, is a very pretty species, found very generally on all the European shores, and is generally regarded as one of our commonest species. The fronds are densely tufted and very much branched, being gradually attenuated upwards to a hair-like fineness. The articulations and siphons of this species may be very distinctly seen under a lens. They differ in length somewhat in different parts of the stem and branches. The siphons are however four, surrounding a small central colourless tube (*c*, Fig. 101). The structure of this species is pretty well represented in the drawings of magnified portions at Fig. 103 ; (*a*) is a ramulus or branchlet containing tetraspores in its central articulations, and is crowned with a tuft of branching fibres ; (*b*) represents an ovate or egg-shaped capsule, containing within it a tuft of pear-shaped spores ; (*c*) is a more highly magnified branchlet, at the tip of which, and at the base of the apical fibres, are three large oblong bodies, which in the living plant are of a bright yellow. These are antheridia, filled with active granules or antherozoids. These antheridia are frequently so abundant on this species, that the branchlets which bear them seem as though they were crowned with a tuft of golden fruit. These bodies, which are supposed to be the representatives of stamens in flowering plants, are found on many species of seaweeds ; but, as Dr. Harvey remarks, "how they act, or whether they act on the spores at all, has not been ascertained." A transverse section of the stem of *P. fibrata*, which contains four siphons arranged around a central colourless tube, is represented at *c*., Fig. 101. *P. fastigiata* is another common species on which antheridia are very frequently found. They are produced in tufts at the tips of the little forked filaments of the plant, and are so conspicuous that they give quite a yellow tint to the plant. This species of *Polysiphonia* is parasitic on *Fucus nodosus* (Fig. 35), or the "knobbed wrack." It grows in dense brownish tufts on the upper branches of the *Fucus*, encircling the stems of the plant, its little intertwined branches pointing upwards, about 2in. in height, and every one of them terminating in a tiny fork. Tetraspores are immersed in the terminal branchlets. Spores are contained in egg-shaped conceptacles. The stem contains no less than eighteen siphons, arranged around a central cavity, which is filled with endochrome. This cavity is, however, not, as in other species of *Polysiphonia*, a continuous tube, but a series of bags of colouring matter, which are separated from each other at the very slight divisions which occur at the articulations or joints of the stem and branches, all of which are shorter than their diameter. A transverse section of the stem is seen at *b*, Fig. 101. This species invariably turns black in drying, and adheres very imperfectly to paper. *P. urceolata*, so named from the urceolate or pitcher-shaped form of its spore-vessels, is found growing on the stems of *Laminaria digitata* (Fig. 46), and some times fringing the shady sides of rock pools, its long red silky filaments mingling with those of the green *Enteromorphæ* or *Cladophoræ*, with occasionally an olive frond or two of a young *Laminaria*,

forming one of those lovely combinations of colour in rock pools which algologists love to gaze on. The capsules of this species are seated on the

FIG. 102. *Polysiphonia nigrescens.*

sides of the branches and ramuli, as seen in a magnified branch at *a*, Fig. 105. Tetraspores are formed in the joints of terminal ramuli, as

FIG. 103. *Polysiphonia fibrata;* (*a*) Ramulus with tetraspores; (*b*) Ovate capsules with spores; (*c*) Magnified branchlet with *antheridia.*

represented at *b*, Fig. 105, which is a more highly magnified branchlet of the beautiful variety of this plant, known hitherto as *P. formosa.* This

is a more delicate plant than *P. urceolata*, though its general appearance is very similar, and the structure is almost identical; (*c*) is a section of the stem, highly magnified. The siphons are four in each of these plants, and the central tube, though small, is filled with endochrome. There is another variety of *P. urceolata*, called *P. patens*, from the patent or spreading character of its branches, which are often reflexed or curled at the tips, and it is very curious that although in the living state this variety is a fine red, it frequently turns black in drying, the capsules contracting and appearing only as little black specks on the stems and branches. These plants, as well as *P. fibrata*, are annuals, and should be looked for in the spring and early summer. *P. fibrillosa* (Fig. 104) is another summer annual, which in some seasons is tolerably abundant, and is met with pretty generally on the British coasts. I have taken specimens of this plant at Hastings which were 12in. long, and frequently the fronds are found from 8in. to 10in. in length. The stem of this species is thick and very obscurely jointed, but when the terminal branches are examined, the articulations are more evident, and the ramuli are generally distinctly two-tubed, the siphons rather longer than broad. Tetraspores are produced in these terminal ramuli, which they distort greatly, as seen at *a*, Fig. 104, and the tips of every filament are crowned with tufts of branched and jointed fibres, a constant character which suggested the specific name of this plant. *P. elongata* (Fig. 104), commonly known as the lobster-horn *Polysiphonia*, (the winter state of the long bare stems and branches being certainly very similar to the antennæ of the lobster) is a hardy, robust species, abundant in rock pools and in deep water. The summer and winter states of this species are widely different. As winter approaches, the ramuli fall away, leaving the lobster-horn stems bare and unsightly; but in the spring the branches put forth tufts of beautiful crimson filaments, each of which is tipped with finely attenuated fibres, the fruit being borne on the young tufted ramuli. There are several varieties of this species described by botanists; but I am inclined to consider them as merely different states of the plant, for in all I find the structure and fructification identical. All the branches and ramuli, but more particularly the latter, are attenuated at each extremity, an invariable character which greatly facilitates identification. The stem and larger branches of the plant are very indistinctly jointed, the surface cells being so small and so closely packed as nearly to hide the articulations and siphons. These are only distinctly apparent in the upper branches and terminal ramuli, as represented in a magnified sprig, at *b*, Fig. 104. The ramulus to the left contains tetraspores, which appear like warty swellings produced alternately on each side of the stem. Winter specimens of this *Polysiphonia* adhere but imperfectly to paper; but spring and summer plants, when clothed with their flaccid multifid ramuli, are easily mounted, and form very attractive book specimens. Fig. 106, represents the charming little plant, *P. parasitica*, one of the most elegant of any of the very beautiful genus to which it belongs. Its usual place of growth is

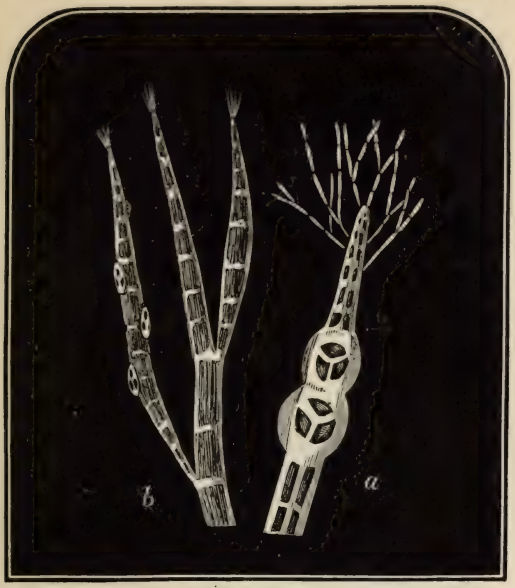


FIG. 104. (*a*) *Polysiphonia fibrillosa*. (*b*) *P. elongata*.

FIG. 105. Branch of *Polysiphonia urceolata*, with ceramidia. (*b*) Branch of *Polysiphonia formosa*; tetraspores in the joints of the ramulus. (*c*) Section of stem.

on the calcareous algæ in deep water, whence its specific name of *parasitica*. It is sometimes found growing on the sheltered sides of ledges of rock, at the extreme limit of low water, and occasionally it is cast ashore in fine condition. Several years ago I found some lovely specimens of this rare *Polysiphonia* on the beach at Whitley, near Tynemouth. I have also taken it in Scotland and at Plymouth. The illustration is from the most perfect of my south Devonshire specimens. Under the microscope a branch of this species is a singularly beautiful object. The ramification of its closely set branches is perfectly regular. They are placed on each side of the stem in alternate series; the same order being observed throughout the entire plant. The tubes in the articulations, when viewed longitudinally, appear to be pointed at both ends, and are separated by transparent or colourless spaces. The siphons are eight in number, sur-

FIG 106. *Polysiphonia parasitica*, magnified.

rounding a narrow cavity. A transverse section of the stem is seen at *d*, Fig. 101. The fronds of this rare little plant rarely exceed 3in. in height, but they are found sometimes in such densely bushy tufts, that a skilful manipulator may easily make several lovely book specimens from a single plant—no small advantage when the rarity of this species is considered. It is, however, widely distributed, being found in Scotland and as far south as the coast of Cornwall. *P. byssoides* is so named from the multifid byssoid ramuli with which the branches are clothed throughout. Dr. Harvey says, "these terminal branched ramuli may probably be regarded as leaves in an imperfect state of development. In other species they are only found on the tips of young fronds, and appear to be actively engaged with the growth of those parts; and while

upon other species they are colourless, in this they partake of the usual crimson or brown-red tint of the plant." The structure of this species under the microscope is remarkably beautiful, every portion of the stem and branches being distinctly jointed, and the dissepiments or separations between the articulations being perfectly pellucid or transparent. The siphons are seven, and surround a colourless tube. Fig. 107 represents two highly magnified branchlets. The capsules, seen at *a*, are very elegant in form, and are produced on short stalks from the upper sides of the articulations. The tetraspores at *b*, are arranged in a single series, being transformations of the three central joints of the branchlet which bears them. This handsome species is widely distributed. I have taken it frequently at Hastings, but much more abundantly at Ventnor, and still more so, and in very great luxuriance, at Plymouth. The fronds are from 6in. to 14in. long, the colour is a fine deep red, which generally changes to a brownish red in drying. *P. variegata* is a remarkably beautiful species, and, although widely dispersed, is rare on the British coasts. I have taken it abundantly in the muddy rocky nooks about Plymouth, but nowhere else. It grows in dense tufts from 5in. to 12in. long. The filaments are very slender, and are attenuated upwards to the most delicate hair-like fineness. The upper portions of the plant are a beautiful purplish-red, which is usually retained in drying. A transverse section of the stem is seen at *e*, Fig. 101. The siphons are six, surrounding a colourless central tube. When viewed under the microscope, the joints of the base are broader than long, and in the main branches twice as long as broad; those in the ramuli are short, but they are distinctly marked with three dark coloured oblong tubes. These characters, which are pretty constant in this species, serve to distinguish it from others which it somewhat outwardly resembles.

I much regret that the extreme difficulty of preparing satisfactory illustrations of this beautiful tribe of plants in the growing state, permits merely a brief mention of many species I would otherwise gladly describe. The noble species *P. Brodiæi*, which I have taken in the Clyde and on the Mewstone Rock, near Plymouth, the branches of which were upwards of 20in. long, would require a plate of folio size to give a fair idea of its grandeur. This species may be known by its large spreading branches, which are alternate and have each a distinct main stem throughout. The stems usually contain seven siphons, the ramuli three or four, rather longer than broad. The colour is a dark brownish-red. *P. violacea* is a beautiful reddish-purple plant, the fronds of which are from 6in. to 12in. high, having a principal main stem set throughout with long alternate branches gradually diminishing in length upwards, all of which are branched again and again, and terminate in tufts of exceedingly slender ramuli. These ultimate ramuli give a pretty feathery appearance to the plant, and in mounting on paper, clot together, and so display the beautiful purple tint of the species to perfection. The joints in the stem, which are very indistinct, are usually marked with irregularly shaped tubes. In the

ramuli the siphons are two or three, and are twice or thrice as long as broad. *P. elongella*, in its summer state, is a highly beautiful plant. It bears a strong resemblance to *P. elongata* (Fig. 104), and, like that species, being biennial, is unsightly during winter, but in spring is clothed with tufts of fine rose-red ramuli. The joints of the stem and main branches are all distinctly marked, and are of equal length and breadth. The siphons are six or seven, and are separated by beautifully pellucid spaces. This species is rare, but widely distributed. I have taken it in Scotland and on the south Devonshire coast. *P. atro-rubescens* is a species which I have taken in Torbay and in Whitsand-bay only. It may be known by the little bundles or bunches of pointed ramuli which are produced alternately along

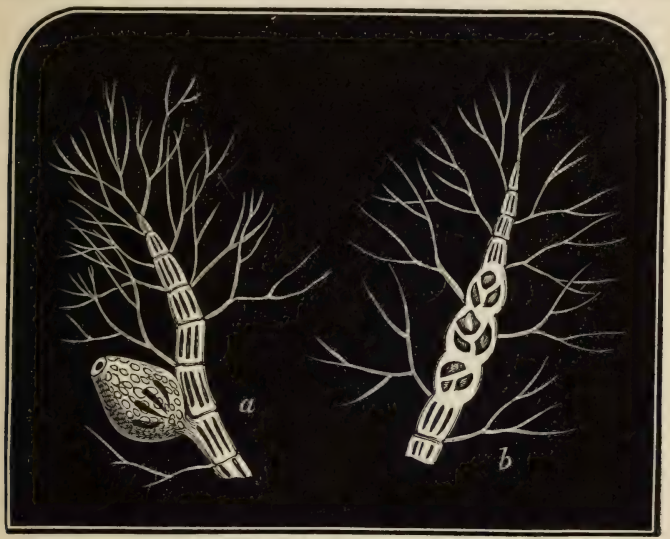


FIG. 107. *Polysiphonia byssoides*; (*a*) Branch with capsules; (*b*) Branch with tetraspores.

the stems, somewhat in the same manner that similarly-tufted branchlets are set on the branches of *Rytiphlœa fruticulosa* (Fig. 99). Under the microscope the tubes in the articulations appear to be spirally curved, a character which serves to mark this species. A transverse cutting of the stem reveals twelve or thirteen siphons. *P. Agardhiana* is a small variety of this species. *P. pulvinata*, now *P. sertularioides*, is a small summer annual, growing on rocks and algæ in dense intricate tufts rarely more than 1in. high. *P. spinulosa* is an extremely rare species found at Appin by the late Captain Carmichael. I possess a single specimen of this plant, taken at Plymouth many years ago, and ever since I have looked for it in vain. *P. Richardsoni*, taken on the coast of Dumfries

by the late Sir John Richardson, is unknown to me. *P. Griffithsianes* now regarded as a variety of *P. subulata*, is found growing on *Polyida, lumbricalis* (Fig. 83), in Torbay, though rarely. *P. Grevillii* found by Dr. Greville on the shores of Bute, parasitical on the larger shore weeds. *P. Carmichœliana*, now a variety of *P. fibrillosa*, found growing on *Desmarestia aculeata* (Fig. 52) by Captain Carmichael. *P. obscura*, a small and rather insignificant species, growing in out-of-the-way places, on the roots of the Fuci and on submerged rocks. *P. simulans*, a rare though widely-dispersed species. It has somewhat the appearance of *P. spinulosa*, the stems being like those of that species, set with spines or short pointed ramuli, which hold the branches of the plant together, trying the patience of the manipulator in disentangling them. Its similarity to some other species is referred to in the specific name of *Simulans*. *P. subulifera* is another spine-bearing species, possessing little beauty, and not frequently met with, though dispersed along the coasts of England and Ireland. *P. furcellata* is a rare and very pretty little species, all the branches being terminated by a little fork, the tips of which incline upwards. This interesting plant is a deep water species. I dredged it in Plymouth Sound some years ago, but have never found it since. It was taken formerly at Sidmouth and dredged in Torbay, but for many years it has disappeared from every locality in which I have sought it. This rareness of some species and occasional disappearance, at least for several seasons, in others, is certainly very curious, and has often formed the subject of ingenious speculation. The causes are doubtless natural enough, if known ; but here I can do no more than record the fact, that while some species are abundant, and make their appearance in the same situations with tolerable regularity, others are rare, and occasionally disappear for many seasons together, then suddenly reappear in their former habitats, and again as unaccountably disappear. The genus *Polysiphonia* contains one species which was discovered subsequently to the publication of the "Phycologia Britannica." Its name is *Polysiphonia fœtidissima*, so called on account of the strong and by no means agreeable odour which it emits during the process of mounting, forming a strange contrast to that of other species, some of which exhale a perfume as delicate as violets. *P. fœtidissima* is very similar in growth and ramification to *P. fibrata*, and indeed some algologists, I believe, consider it to be merely a variety of *P. fibrata*, though the colour is very much darker, inclining to a blackish tint ; and it is curious that the odour emitted by each of these species is alike, that of *P. fœtidissima* being rather the more disagreeable of the two.

The genus *Dasya*, or hairy-branch, is a numerous and considerably diversified group of plants, all being more or less remarkable for their brilliant crimson hue. Of the British species, the largest and most abundant is the handsome and well-known *Dasya coccinea*, or the scarlet dasya, a branch of which is represented slightly magnified at Fig. 108. The plants in this group are chiefly characterised by the tufts of thread-like jointed ramuli which clothe all the branches of these algæ, and are of

a similar structure to the fibres which are found on the tips of many of the *Polysiphoniæ*, but while in that genus these fibres are nearly always colourless, and perish as the plants advance towards maturity, and are not in any way connected with the fructification of the plants, in the *Dasyæ* they are brilliantly coloured, and are as enduring as the plants themselves; the stichidia, or vessels which bear the tetraspores, being a transformation of portions of these tufted ramuli. The ceramidium, or spore-vessel, is also a metamorphosis of some of these ramuli, and is an interesting and beautiful object for the microscope, a number of crimson pear-shaped spores being distinctly visible through the semi-transparent walls of the

FIG. 108. *Dasya Coccinea.*

fruit-vessel. The stichidia are oblong lanceolate pods, suddenly pointed at the tips, and contain the tetraspores, which are arranged in a series of transverse bands. *D. coccinea* is a summer annual. Small stunted forms are met with growing in pools between tide marks, but luxuriant specimens are only obtainable in sheltered situations at extreme low-water mark, though occasionally they are cast ashore from deep water. The most favourable situations for this species, known to me, are the bays around Bovisand near Plymouth, and the shores west of Ventnor, in the Isle of Wight. *D. ocellata*, so named from a fancied resemblance which the tips

of the tufted branches bear to the eye-like spots on the peacock's tail-feathers, is a small and rare species, seldom more than 2in. high. It grows on muddy rocks at extreme low-water mark. The ramuli, which are very abundantly produced on each side of the stems, are so fine and so closely set, that a satisfactory figure of the living plant is hardly possible; I therefore present my readers with the representation of a highly magnified branchlet (Fig. 109). In this species the ramuli are forked, and are of extreme tenuity. Lanceolate stichidia, which point upwards in the direction of the main stem, are seated on the upper side of the ramuli. *D. arbuscula*, or the shrub-like dasya, is another small and rare species, about 4in. high. It is excessively branched and bushy, the branches being densely clothed with forked-spreading ramuli, which are so crowded at the tips as to give the outline of the plant the appearance of a bunch of crimson feathers. I have taken beautiful specimens of this species on the shaded side of the great Mewstone Rock, near Plymouth. Fine specimens are sometimes taken on the Irish and Scottish coasts. In this country *D. ocellata* rarely produces ceramidia, but *D. arbuscula* is as frequently found with capsules as with stichidia, but the form of the latter is very distinct in these species; those of *D. ocellata* being long, narrow, and drawn out to a fine point; while in *D. arbuscula* they are oblong, obtuse at the tips, and terminate with a mucro or short spine. The ceramidia of this genus are very pretty objects. They differ considerably in form in the various species. That represented at Fig. 110 is the characteristic capsule of the Jersey species, *D. Venusta*, now *D. corymbifera*. It is produced, as I have said, from the branched ramuli, and is a transformation of one of the branches on the lower side of the tufts, the spores being developed from the endochrome or colouring matter of the joints of the ramulus. *D. Venusta*, or *D. corymbifera*, is a highly beautiful species. It is abundant in the Channel Islands, and occasionally cast ashore on the coast of Sussex. *D. punicea*, the purple dasya, is another rarity, and is also of small size. I have never found it growing, but have picked it up on the shore near Brighton, where it has also been taken by my friend Mrs. Merrifield, one of the most accomplished algologists in England. *D. Cattlowiæ* is unknown to me, and, so far as I know, has been met with in the Island of Jersey only, where it was discovered by Miss Cattlow, in 1858.

The Order *Corallinaceæ*, so called from the coral-like appearance of many of these vegetable productions, contains a large number of very remarkable plants, all of which have the singular property of absorbing carbonate of lime into their tissues. Some of them are filiform or stringlike, and are branched in a pinnated or dichotomous manner, the wing-like or forked branches being composed of a succession of chalky articulations. The root of these is an expanded crust-like disc, which is firmly attached by its under surface to the rocky sides of tide pools. Other branching species are parasitic on various kinds of seaweeds, while several of the lowest forms of this order are thin, stony incrustations, spreading over the surface of rocks; and some others, of a similar structure, are found firmly attached

Fig. 109. Terminal branch of *Dasya ocellata*, highly magnified.

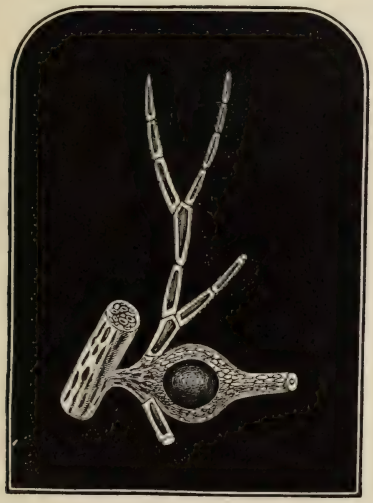


Fig. 110. Portion of a stem with ramulus of *Dasya venusta*, showing the ceramidium with spores.

to the fronds of several of the membranous algæ. Most of these latter species belong to the sub-order *Nulliporeæ*, some of which vegetate only in deep water, and are thus unobtainable except by dredging. The plants of this Order are found in all seas, but are most abundant in warm climates, and some of the tropical species are among the most beautiful and curious of the oceanic flora. Many of these plants were formerly regarded as of an animal rather than of a vegetable nature, and until lately they were classed among the zoophytes or polyp-bearing corals. They are, however, now known to be true vegetables; for upon the plants

Fig. 111. *Corallina officinalis.*

being immersed in strong acid, the limy coating of their fronds is dissolved, and the vegetable structure is at once revealed. The fructification in this Order is tetrasporic, but, curiously enough, is, for the most part, contained in conceptacles which are very similar in form to those which, in other genera, contain spores. This assemblage of plants consists of two distinctly marked sub-orders. The first of these, called *Corallineæ*, contains the branched and jointed species. Fig. 111, represents a branch of the well-known *Corallina officinalis*, the most abundant of th

British species. It is found in rock pools at all seasons of the year, its pretty rose-red fronds fringing the sides of the pools, and in the fruiting season being dotted here and there with little white roundish or urn-shaped ceramidia, which are produced from the terminal joints of the ramuli, or sometimes from the sides of the branches, two or more egg-shaped capsules springing from the same joint, but always of the same chalky white colour. The fronds vary in length from 2in. to 6in. or more, according to the depth of water in which they grow, or the shelter afforded them by the larger algæ. The species *C. squamata* is rare, and though very similar to the foregoing, may be known by the form of its upper joints, which are much flatter than those of *C. officinalis*, and the upper angles are pointed and distinctly prominent.

The genus *Jania*, from Janira, one of the Nereides, contains two small species, which are parasitic in dense pinky tufts on several of the smaller algæ. *Jania rubens* is found on all parts of the British coasts, while *J. corniculata* is chiefly an inhabitant of the southern shores of England and Ireland. Fig. 112 represents terminal branches of both species highly magnified; *a*, is a terminal sprig of *Jania rubens*, *b*, of *J. corniculata*. These plants, in the living state, very closely resemble each other, but the microscope reveals a very marked difference. In *J. rubens*, it will be seen that the joints have rounded angles, while in *J. corniculata*, the angles are sharp and prominent, and the articulations taper a little at the base. The ceramidia in each have long horns like the antennæ of a beetle, and in *J. corniculata* these horns are each tipped with a ceramidium, from the upper angles of which spring two horn-like ramuli, generally somewhat incurved at the tips.

The second sub-order of the *Corallinaceæ* contains that curious group of marine productions which, to outward appearance, bear little resemblance to plants (unless it be some of the crustaceous lichens), and possess little beauty to recommend them to the notice of any but scientific botanists. These are the *Nullipores*, some of which are foliaceous, and free or unattached; others are merely chalky incrustations, spreading over rocks and stones, and some few have their place of growth on the fronds of other seaweeds. Most of these are included in the genus *Melobesia*; but as many of them are inhabitants of deep water, or otherwise not generally accessible, and rarely met with in good condition, I will merely describe one or two species that are frequently found on the fronds of *Phyllophora rubens* (Figs. 113 and 149) and *Chondrus crispus* (Fig. 162). These are *Melobesia verrucata* and *M. pustulata*, the former of which is a thin chalky expansion of irregular shape attached to one surface of the seaweed; the latter is also of irregular form, but generally oblong, and it sometimes incrusts both surfaces of the plant on which it grows. A frond of *Phyllophora rubens*, at Fig. 113, represents the manner in which *Melobesia pustulata* is constantly found attached to this red seaweed, defying all attempts at mounting the alga on paper until the calcareous parasite is scraped off. The little roundish dots on the surface of the *Melobesia*

are ceramidia, with a pore or opening at the top, through which, at maturity, the tetraspores escape into the water. The name *Melobesia* is from one of the sea-nymphs of Hesiod. One of the commonest of these encrusting

FIG. 112. Terminal branches, highly magnified, of (*a*) *Jania rubens*; (*b*) *Jania corniculata*.

marine productions is the well-known *Hildenbrandtia rubra*, which is frequently found in extensive patches of a beautiful rosy tint on rocks near low-water mark, or lining the lower surfaces of tide pools under the

FIG. 113. *Melobesia pustulata*, parasitic on *Phyllophora rubens*.

shelter of the *Fuci* or Kelpweeds. This species is a thin membranous crust, and is attached so firmly to the surface of the rock, that it is impossible to separate a portion for preservation as a specimen. This

curious production was formerly included in the *Corallinaceæ;* but its structure, which is more of a leathery than a stony nature, has caused it to be removed from the calcareous order of marine algæ, and associated with a small group of singular plants, which, like itself, are either circular or irregularly shaped patches of a red or brownish-red colour, which are found on stones and shells, or attached by means of minute fibres on their under sides to the surfaces of rocks. The order *Squamarieæ* has been formed for their reception. In addition to the species just described, I will merely mention the names of the others, since they possess very little interest for the ordinary collector. They are as follows: *Peyssonelia Dubyi, Petrocelis cruenta, Cruoria pellita*, and *Cruoria adhærens.*

The Order *Sphærococcoideæ*, so named from the roundish form of the fruit, is an assemblage of seaweeds, of a rosy or blood-red colour, some of which are leafy, others consist of broad, expanding, cleft, or laciniated membranes, and some few are filiform, and more or less branched. At the head of this Order stands the genus *Delesseria*, named in honour of M. Delessert, a French botanist; and here I must express my regret that the charming plant, which until recently was known as *Delesseria sanguinea*, has been removed, not only from this genus, but has been placed in another Order, "a measure," writes Dr. Harvey, "rendered necessary by the new principles of arrangement developed by Professor Agardh," whose system is now generally adopted by algologists. In outward appearance, and even in the internal structure of its stem and leaves, this fine species is a true *Delesseria*, but the structure of its fruit being very different from that of the *Sphærococcoideæ*, it has very properly been transferred to the Order *Rhodymeniaceæ*, and is now known as *Maugeria sanguinea*, a name which was given to it by S. O. Gray, Esq., in his work on "British Seaweeds," published in 1867. However, for the convenience of those who have been accustomed to regard this plant as *Delesseria sanguinea*, I will figure and describe it before I pass on to a description of the beautiful leafy plants now included in the genus *Delesseria.*

Maugeria sanguinea, represented at Fig. 114, is one of the most striking and beautiful of all the British red seaweeds. In its perfect summer state when grown in favourable situations in deep water, the fronds are from 6in. to 8in. or 10in. long, and from 2in. to 6in. wide; each leafy expansion has a short stalk and a distinct midrib with veins on each side, the margin of the membranous leaves being entire, and often beautifully waved, so that when fully grown plants are mounted on paper, they present the most beautiful variety of pink and deep red tints, owing to the folding over of the delicate membranous margins. Occasionally in proliferous specimens, long narrow leaflets are thrown out from the midrib of the primary leaves. Small but beautiful forms of this leafy plant are found sometimes in shady rock pools, but always submerged, and mostly under the shelter of the larger olive weeds. The winter state of this plant is very different to its summer condition. All the delicate wavy margin disappears, and from each side of the midrib springs a series of ovate leaflets (*sporophylla*), in

Fig. 114. *Maugeria sanguinea.*

Fig. 115. *Delesseria sinuosa.*

which the tetraspores are placed. Tubercles (on other individuals of the species), which are produced on short stalks, fringe the stems and midribs, and contain the spores. Old stems which have not been disturbed during winter put forth a new crop of leaves as the spring advances, and I have always observed that the colour of these biennial specimens is always more brilliant than that of plants of the first season. This species is found in tolerable abundance all round the British coasts; it is met with on most of the Atlantic shores of Europe, and in several situations in the southern hemisphere. It is easily displayed on paper, and is deservedly a universal favourite. *Delesseria sinuosa*, represented at Fig. 115, commonly known as the "Oak-leaf Delesseria," is extremely variable in the size and form of its leaves. Some are long, narrow, and sinuated, jagged or cleft from the margin to the midrib; while others are broad and hardly cleft at all, being very slightly sinuated or indentated, such specimens bearing a very striking resemblance to young oak leaves. Its place of growth is on the stems of the deep water *Laminaria digitata* (Fig. 46), portions of which are often cast ashore with splendid bunches of this *Delesseria* attached to them. In this species the midrib is very distinct, and in full grown plants is strong and wiry, presenting occasionally no small difficulty in mounting the specimen in a natural position. Each lobed portion of these oak-like leaves is traversed by a prominent vein, which arises on each side of the midrib and terminates only with the margin of the leafy membrane. These veins in the leaves of the *Delesseriæ*, are nothing more than a closer aggregation of deep-coloured cells; but the mid-ribs, although composed entirely of cellular matter, thicken and harden into a wiry, stick-like substance, and become the stems from which subsequent branches and leaves are produced. The colour is a deep brownish red, turning to a greenish yellow in decay. Spore-bearing tubercles are produced in the midribs; tetraspores are placed in little slender marginal leaflets, which are sometimes so abundant, that the leaves of such specimens appear as though they were fringed with cilia. This species is biennial, and is abundant on the Devonshire coasts, being particularly fine in Torbay and in the neighbourhood of Plymouth. *D. alata* is the most common species of this genus. It grows in rock pools under the shade of the *Fuci*, or kelpweeds, and on the stems of *Laminaria digitata* (Fig. 46). The fronds vary in length from 3in. to 10in. or more. They are much branched, and all are furnished on each side of the midrib with a winglike membrane, which is entire at its margin, and varies in width from one line to $\frac{1}{4}$in. In mounting luxuriant specimens of this plant, it is very desirable to cut away superabundant branches; otherwise the delicate membrane on each side of them cannot be effectively displayed; neither can the beautiful transverse striæ with which its surface is marked be made out under the lens, unless the branches are separated from each other. Spores are contained in spherical tubercles produced from the midrib; tetraspores are placed in leaflets which arise from the angles of the upper branches, or sometimes on each side of the midrib in the tips of the terminal branches. Fig. 116, represents a branch of *D.*

alata. In Fig. 117, *a*, is a magnified branch, showing the manner in which the tetraspores are arranged on each side of the midrib, when they are produced in the branches of this species. The variety *angustissima* is

FIG. 116. *Delesseria alata*.

the narrowest in the frond of any form of this species with which I am acquainted; and so far as my experience goes, it is peculiar to the northern

FIG. 117. (*a*) Branchlet of *Delesseria alata*; (*b*) *D. ruscifolia*; (*c*) vertical cutting of tubercle of *Nitophyllum Gmelini*.

coasts of England. During two seasons of seaweed gathering, on the shores north of the Tyne, I always met with this extremely narrow form, and never with the broader varieties which are common on the southern shores.

But, as regards the species *D. angustissima*, I can only say, I have never met with it in the growing state; the only specimen I possess was given to me by the late Dr. Cocks, of Plymouth, who received it, with some others, from Mrs. Griffiths, of Torquay, that lady having found it in Torbay, about the time it was discovered by Mr. Brodie, more than fifty years ago. The fructification of this rare plant seems to me to be identical with that of *D. alata*, and the only difference that I have been able to discover between it and the narrowest form of *D. alata* in my possession, is the extreme tenuity, or perhaps even the absence of the lateral membrane which is always present in the narrowest form of *D. alata*, var. *angustissima*. In Fig. 117, *b*, is represented an enlarged leaf of the pretty species *D. ruscifolia*. The leaflet arising from the midrib shows the order of growth in this proliferous species, luxuriant specimens being like balls of

FIG. 118. *Delesseria hypoglossum*.

crimson leaves. This is the smallest of the genus, and though it is sometimes found on the stems of *Laminaria digitata* (Fig. 46), its more frequent place of growth is on mud-covered rocks near low-water mark. Many years ago I used to take it in great quantity and beauty on the muddy rocks near Mount Batten at Plymouth. In our illustration the coccidium, or spore-bearing tubercle, is represented (as is usual in the *Delesseriæ*) as produced from the centre of the midrib, a short distance only below the tip of the leaf. Tetraspores are arranged in oblong groups on each side of the midrib, and generally near the tips of the rounded leaves of the plant. The colour is always a rich deep crimson, and with a little judicious pruning, this species makes an exquisite book specimen. The only British seaweed with which this species may be confounded is *D. hypoglossum*, represented at Fig. 118. In this, however, the fronds are longer and

narrower, lanceolate, or pointed at the tips, and of a much lighter colour, being of a pale rose or delicate pink. The fronds of this species are tufted and originate in a single lanceolate leaf, having a distinctly marked midrib, from which it throws out other similar leaves, and from these are produced others, which in turn bear another series; and in this manner the primary leaf-like frond becomes clothed with leaves of various lengths, which spread out in the water, and give a somewhat circular outline to the plant. Coccidia are produced on the midrib, as represented in our illustration; tetraspores are disposed in long narrow lines on each side of the midrib, near the tips of the leaves. Barren specimens are generally the most luxuriant, those in fruit being much narrower, and of a paler colour. This beautiful species is annual. It grows in shady rock pools and on the stems of the *Laminaria*. It is rare in Scotland, but tolerably abundant on the south coast of Devon, and particularly fine at Plymouth, and at Bantry Bay, in Ireland.

Very nearly related to *Delesseria* is the genus *Nitophyllum*, a tribe of membranaceous plants, which are distinguished chiefly by their more or less broad lobes, rather than leaves or branches. None of these plants are furnished with a midrib, though some species have tolerably distinct veins, very strongly marked at the base, but vanishing gradually as they ascend into the upper divisions of the plants. Most of the species in drying have a fine polished shining surface, whence the generic name of *Nitophyllum*, or shining leaf. The fine species, *Nitophyllum Hilliæ* (Fig. 119) was named by Dr. Greville in honour of Miss Hill, who discovered it. The plant arises from a small disc-like root, and rapidly expands into a roundish or fan-shaped frond, from 8 inches to 20 inches in circumference, which is cleft all round its margin into irregularly shaped lobes of large size. Veins, more or less waved, arise from the base, and sometimes spread over the surface of the frond. Globular tubercles containing spores are scattered over the whole of the plant. Tetraspores are produced in the upper part of the lobes, and being very minute, appear like little granular spots. The colour is a fine rose red, which it preserves in drying. *N. Bonnemaisoni* is very rare, though found on all the British shores. It grows on the stems of *Laminaria digitata* (Fig. 46). The fronds are seldom more than 4in. long, the segments are deeply cleft, and are about as broad as long. The tubercles are smaller than those in *N. Hilliæ*, but the groups of tetraspores are larger. The substance is much more delicate than that of the foregoing species, and the colour is a beautiful rose pink. *N. Gmelini* is another somewhat rare species. I have found it at Hastings, though once only; but at Plymouth it is generally abundant and sometimes of large size. The fronds are more or less deeply cleft, some specimens being even jagged at the margin, others having beautifully rounded lobes, and occasionally some are divided into long ribbon-like segments, while all have a distinctly rounded outline. The colour is a deep red, often inclining to a brownish purple. Tubercles are scattered over the surface of the frond, but the tetraspores are invariably produced in groups just

within the margin. A vertical cutting of one of the tubercles or coccidia of this species, very highly magnified, is represented at *c*. Fig. 117. The spores are developed in the terminal cells of the branched threads which arise from a placenta, or basal projection, in the centre of the tubercle. The arrangement of the spore-threads and production of the spores at their tips, is very similar in the coccidia of the *Delesseriæ*, but the form is a little different. The tubercles in the *Nitophylla* are usually longer than high, when viewed as represented in Fig. 117; but in the *Delesseriæ* they are more generally spherical, and the spore-threads are set more upright and closer together. *N. laceratum* (Fig. 120) is one of the most abundant of the genus. It grows under the shelter of the larger algæ, and is often found attached to *Corallina officinalis* (Fig. 111) in rock pools about half-

FIG. 119. *Nitophyllum Hilliæ.*

tide level. In form and size it is very variable, deep-water specimens only being of large size, and broad in the segments of the frond; these are generally found on the stems of *Laminaria digitata* (Fig. 46). In shallow pools this species rarely exceeds 6in., but I have gathered specimens on the shore at Exmouth and near Plymouth that would easily have covered a folio page. Fig. 120 was taken from one of my Exmouth plants, the fronds of which were 12in. long. This species, when viewed in clear rock pools under the influence of sunlight, is beautifully iridescent. The fronds are dichotomous, or branched by repeated forkings; the margins are sometimes smooth and even, but more frequently waved and notched, and occasionally the long segments are twisted or curled, and very much interwoven. Some specimens are fringed with little ciliated or narrow leafy processes,

and one small variety has its laciniations hooked at the extremities in the shape of a sickle. The lower parts of the fronds are very distinctly veined. Spherical sori or round tubercles are scattered here and there over the fronds, but not numerously; tetraspores are arranged in spots within the margin of the segments, or borne in the leaflets which fringe the fronds in some specimens. The colour is usually a rosy pink, sometimes inclining to a pale purple. This species does not always adhere well to paper. Whenever I am troubled in this way, with good plants of this or any other species, my invariable rule is to immerse them, paper as well, in skimmed milk, and then dry and press them as before. This process does not affect the colour or condition of the plants in any way, but it causes them to adhere permanently to the paper, more satisfactorily than by any other method I have ever heard of. *N. versicolor* is, *par excellence*, the rarity of this genus. It is seldom, if ever, found growing, being most probably a deep-water plant. Minehead, and down the coast above and below Ilfracombe, are the only localities in this country where it is found cast ashore. The plant, which is seldom more than 2in. high, arises from a short but distinct stem, and expands into a fan-shaped frond, which is cleft into a few more or less rounded segments. The colour is rose-red, changing to a bright orange by contact with fresh water; hence the specific name of *versicolor*. Tubercles, very recently discovered on a specimen taken at Ilfracombe, and identified as such by Mrs. Merrifield, of Brighton, are scattered over the upper part of the lobed segments. This is, I believe, the first recorded instance of the fruit of this rare species having been detected on British specimens. Occasionally specimens are found with the tips of the lobes curled over and hardened into processes which, some writers believe, drop off at maturity and develop into new plants. This opinion was communicated to me by Miss Gifford, of Minehead, a well-known and highly scientific botanist, who has had such frequent opportunities for observing the appearance of this curious plant, and the constant development of the callous tips of its fronds, that I am inclined to accept this lady's explanation of the object of these singular apical processes on the fronds of *N. versicolor*. Fig. 121 represents a portion of one of Miss Gifford's plants, of the natural size. I will now describe two forms of that highly beautiful species, *N. punctatum*, specifically named from the numerous and very distinct dots or groups of tetraspores so frequently found on these plants. The forms are so numerous that botanists name and describe no less than five distinct varieties.

These beautiful plants are attached to other sea-weeds, but they mostly grow in deep water, and are found in some form or other on all the British coasts. The typical form, as represented at Fig. 122, is at first a broad wedge-shaped membrane, which grows out into a dichotomously divided frond; each division terminating in several short, finger-like lobules, with rounded axils and tips of a lovely rose-colour, the lower portions of the plant being of a paler tint. Mature plants sometimes attain a circumference of 2ft. or more. Tubercles are scattered over the surface of the

Fig. 120. *Nitophyllum laceratum.*

Fig. 121. *Nitophyllum versicolor.*

fronds; tetraspores, which are very numerous when present, are produced in groups of large size, and these are sometimes confined to the segments of the frond. Their number, size, and brilliant colour afford marks by

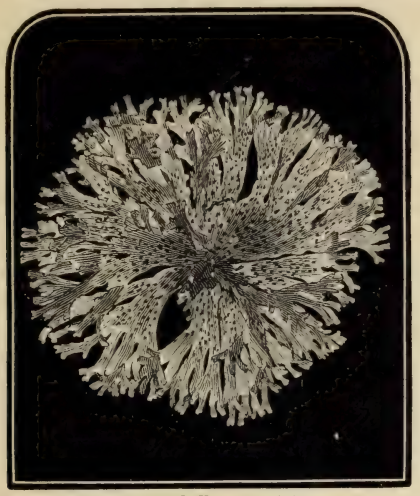


Fig 122. *Nitophyllum punctatum.*

which every variety of this species may always be recognised. In the variety, *N. ocellatum*, Fig. 123, the tetrasporic spots are particularly large; and they are rendered still more striking by being developed in the long,

Fig. 123. *Nitophyllum punctatum*, var. *Ocellatum.*

narrow, linear segments into which this variety is cleft down to the base of the frond. The margins of all the divisions are perfectly smooth and flat; while in the variety *crispatum*, and others, the segments are similarly

cleft, and are curled, waved, or fimbriated at the margins—characters which serve to denote varieties, though they all undoubtedly belong to the same species—differing in form merely in different localities, or from some circumstances connected perhaps with climatic influences affecting their growth. My largest specimens were taken in Plymouth harbour, the segments of which were from 6in. to 10in. long; but these are pigmies in comparison with specimens found in the north of Ireland, some of which are over 3ft. in length and 2ft. in breadth. Among the recent additions which have been made to the marine flora of this country is that of the new species *Nitophyllum thysanorhizans*, discovered by Mr. Holmes at Plymouth. The peculiarities of this new species consist, firstly, in the position of the tetraspores, which are placed within the terminal lobes of the segments; secondly, of a series of minute veins, which traverse the fronds throughout; and, thirdly, in the production of tufts of root-like processes, which fringe the margins of the segments.

The two plants *Calliblepharis ciliata* and *C. jubata* were, until lately, included in the genus *Rhodymenia*; but as the structure of their spore-producing organs does not accord with the principle of fructification in the *Rhodymeniaceæ*, the genus *Calliblepharis* has been formed for their reception, and now they follow the *Nitophylla* in the Order *Sphærococcoideæ*. With the first of these (*Calliblepharis ciliata*, Fig. 124), both names have reference to the beautiful eyelash-like cilia, which border the segments of the fronds and contain the spores. The plant arises from a creeping fibrous root, and is at first a narrow pointed leaf, from 3in. to 6in. long, tapered at the base and acute at the tip; the cilia, which are put forth from the margin, develop into branches similar in form to the primary leaf, and thus the species becomes foliiferous, each leafy segment being ciliated on each side, and sometimes even on the surface. At maturity, which is reached on the approach of winter, the spherical tubercles begin to appear, swelling the cilia about the centre, and bending the tips down at an angle which gives these little processes a remarkable resemblance to a duck's head, the sporiferous nucleus in the rounded angle occupying the place of the eye of the bird. This peculiarity is represented at *b* (Fig. 124). The tetraspores, which are contained in cloudy patches, are dispersed over the surface of the fronds. The colour varies from a dull pink to a full red. The plant is annual, and is cast ashore all along the south coast of England. *C. jubata* (Fig. 125), is nearly allied to the former species, and is frequently mistaken for it by young collectors. It is, however, a summer annual, and fruits before autumn; it is frequently found growing abundantly in rock pools; but *C. ciliata* fruits in winter, and is thrown ashore from deep water. The tetrasporic fruit of *C. jubata* is also produced in a different situation, being confined to the cilia, in which the spores are also produced. In early growth the cilia of this species are short and needle-pointed; but, as the plant advances towards maturity, they lengthen and become filiform, and in luxuriant specimens they curl and twist round the fronds, and even round those of other plants near them, like the tendrils of a creeping

land-plant. In shallow pools the colour of this species often loses all its fine red tint, and becomes a pale olive or dull yellow; but in shady situations,

Fig. 124. *Calliblepharis ciliata.* *b*. Magnified cilia with tubercles.

or when cast ashore from deep water, the colour is a full rich red, which generally becomes darker in drying. As the fronds of these plants are

Fig. 125. *Calliblepharis jubata.*

tolerably thick and of a somewhat leathery substance, they are apt to shrink in drying, and crimp the paper in an unsightly manner. When

this is the case (and it always occurs with mature plants), I refloat the specimen in sea water and mount it afresh on another sheet of paper, when, if it fail to adhere firmly, I have recourse to the milk jug, as already described.

The curious plant which is represented by a magnified branch at Fig. 126 is called *Sphærococcus coronopifolius*, a name which, though highly characteristic, makes me regret that this, like multitudes of other red seaweeds, has no common name. My non-classical readers must be content with the information that the names of this species signify, "spherical fruit crowning the foliage or branchlets." The coccidia, or spore-bearing tubercles, are produced just below the tips of the ramuli; the apices being continued beyond the fruit-vessel in the form of a short mucro or spine. This species is rare in Scotland, but is cast ashore on the South of England and Ireland, some seasons rather plentifully. Several years ago I took large and beautifully fruited specimens at Ventnor, thrown ashore for several days in succession; and in 1873 fine specimens, also in fruit, were sent to me from Cornwall, by H. Goode, Esq., an enthusiastic and successful collector. The colour of this plant is a fine scarlet, but the substance is so crisp and horny, that a considerable amount of pruning of its rigid branches is necessary before the plant can be mounted effectively on paper. Even then it adheres but imperfectly, and recourse must be had to the plan I have more than once recommended in these pages, that of refloating and immersing the specimen in skimmed milk.

The genus *Gracilaria*, from the Latin *gracilis*, in allusion to the slender branches of the typical species, contains a variety of widely dispersed plants, some of which are employed in the manufacture of glues and varnishes. One of our rare species, *G. compressa*, having a soft brittle frond, makes a capital preserve, as well as pickle. The late Mrs. Griffiths, of Torquay, presuming this species to be identical with an Indian alga known as "Ceylon moss," made an experiment with the British plant, and found it to answer equally well as a pickle and a preserve. *G. compressa* is a deep-water species, but is thrown ashore on various parts of the Devonshire coast. The fronds are tufted, and arise from a disc-like root. The branches are long, and are set alternately along the stem, which is cylindrical, but somewhat flattened at the sides, the branches being similarly constructed, but tapered at the base and the tips. Tubercles of large size are produced plentifully on the sides of the branches. Tetraspores, which are very minute, are concealed in the branchlets. The colour is a dull pink; the plant is annual, and is in perfection from July to the end of August. Fig. 127 represents the common species, *G. confervoides*. This is a most variable plant; the fronds are tufted, and are from 4in. to 20in. long. The branches are by no means numerous and are very irregularly disposed; they are round and string-like, and taper at both ends. Roundish tubercles are scattered on all sides of the branches. The colour is a dull red, which changes to a pale yellow on exposure to sunlight, and in decay

becomes a waxy white. The species is perennial, and is abundant on the British coasts. The rare and beautiful species, *G. multipartita*, Fig. 128, is dredged in Plymouth Sound, where it attains very unusual dimensions,

FIG. 126. Terminal branch of *Sphærococcus coronopifolius* (magnified).

the fronds being often over 12in. long, tufted and branched so as to spread out into a circle of 2ft. in circumference. The fronds are cleft nearly to the base, the branches are flat and are numerously and irregularly divided.

FIG. 127. *Gracilaria confervoides.*

FIG. 128. *Gracilaria multipartita.*

When first gathered, the fronds are soft and brittle; but in drying they shrink and become tough, and adhere tolerably well to paper. The capsules are large and prominent, and are scattered abundantly over the

frond. The colour is a dull purplish red, occasionally marked by delicate tints of pink, and in drying, is tinged here and there with faint shades of green. Although this species is a rarity, it is widely dispersed, being found in various situations north and south of the equator.

The genus *Gelidium*, which was formerly included in the extensive Order, *Cryptonemiaceæ*, is now the only British representative of the newly arranged Order, *Gelidiaceæ*, a group of plants of a horny or cartilaginous substance, which are represented in one form or other in almost all seas. The well known *Gelidium corneum* is a most variable plant; so much so, indeed, that in order to characterise the numerous forms satisfactorily, Dr. Harvey has named and described no less than thirteen varieties, all of which are found in various situations around the British coasts. The figures of the varieties which I am about to describe are from branches of plants in my possession, each of which is typical of its particular variety, and these will help students to identify similar plants of this genus, the varieties I have figured being those most commonly met with. In Fig. 129, *a* represents a branch of variety *flexuosum*, the fronds of which are from 2in. to 4in. high. The branches are long and narrow, but decreasing in length as they approach the summit of the stems. The branches are mostly opposite, spreading out widely from the stem, and sparingly set with short, blunt, or sometimes pointed ramuli; *b* is a larger branch of the var. *pinnatum*. The fronds are from 4in. to 6in. high. They are more copiously branched than the foregoing, and the stems are thicker, and they are set throughout with spreading pinnæ or wing-like branches, which are blunt at the tips; *c* is the pretty and very distinct var. *latifolium*, so called from its very broad flat stem and branches. The fronds are usually 3in. or 4in. high; the secondary branches are mostly simple, but all are set with short bristle-like pinnulæ or ramuli. In Fig. 130, *d* is a terminal branch (slightly enlarged) of var. *pulchellum*, the fronds of which are about 4in. high, capillary or hair-like: long, thin, and generally straight, the stems being set on each side with short pinnæ, mostly of uniform length, tapered at their insertion, and obtuse or blunt at the tip. The spore-bearing tubercle of this genus is called "*favellidium*," and this is usually elliptical in form, and is produced just below the tips of the ramuli, which it swells or bulges out, the central portion being of a deeper red than the rest of the pinnule. A fruited branch of a narrow form of *Gelidium latifolium* is represented at *e*, Fig. 130. Most of the short ramuli on each side of the stem bear favellidia near the tips. Var. *aculeatum*, is a somewhat rarer plant than the foregoing, the fronds are about 2in. high, irregularly divided, but much branched, the lesser branches being somewhat crowded towards the summit of the stem. All the branches have acute tips, and are set with short, spreading, sharp-pointed ramuli, a character which is constant, and is referred to in the specific name. A frond of this variety is represented at *f*, Fig. 130, enlarged about a third of the natural size. Two very curious and rather rare varieties are represented in Fig. 131, where *g* is a terminal branch of var. *crinale*, the natural

FIG. 129. *Gelidium corneum* :—(*a*) var. *flexuosum* ; (*b*) var. *pinnatum* ; (*c*) var. *latifolia*..

FIG. 130. *Gelidium corneum* :—(d) var. *pulchellum* ; var. *latifolia* in fruit ; (*f*) var. *aculeatum*.

FIG. 131. *Gelidium corneum* :—(*g*) var. *crinale* ; (*h*) var. *abnorme*.

size. The fronds are hair-like and very thin, seldom over 2in. long, sparingly branched below, but forked above, and usually terminating in one or two trifid tips; *h*, is a small branch of var. *abnorme*, a very curious form, found chiefly on the Cornish coast. The fronds are about 2in. high, the branches are alternate, and produce here and there two or three very short

Fig. 132. *Nemaleon multifidum.*

ramuli, which are either deflexed or set at right angles with the stems. This variety is also found on the Cornish shores. One of the smallest of this group is the tiny var. *clavatum*, the fronds being scarcely 2in. high; the branches and ramuli are attenuated at their insertion and club-shaped at the tips. This variety is found in Scotland as well as on the south coast of England. The granular fruit of these plants, which is usually *disporic*, being apparently composed of two parts only, is placed in the ultimate ramuli or lesser branchlets. The colour of most of them is generally a dull red, becoming lighter in decay, but the var. *latifolium* is always a bright rich red, and when found growing in shady rock pools under the *Fuci*, the colour is often a brilliant crimson. These horny plants rarely adhere well to paper, but when they are nicely displayed and thoroughly dried, they may be permanently secured to paper by applying to the under side of the fronds a mixture composed of isinglass dissolved in spirits of wine.

The Order *Helminthocladieæ* is a small group of plants, most of which are composed of branching filaments, set in a kind of loose but tenacious gelatinous matter. When gathered fresh from the sea they are remarkably like a lot of slimy worms entwined together, hence the name of the Order, which signifies "worm-like branches." The spores of these plants are round and very minute, and are borne on branched filaments which radiate from the axis of the stems. They are not produced in conceptacles of any kind, but are merely attached to the gelatinous threads which form the periphery or outer margin of the frond. Tetraspores are borne in the marginal cells of the external filaments. Fig. 132 represents a complete plant of *Nemaleon multifidum*, the names signifying "much-divided crop of threads," in reference to the division or branching of the fronds, and the numerous threads or filaments of which they are composed. The

fronds vary from 3in. to 6in. in length, and are irregularly branched from the base, the branches terminating in a fork; some are trifid, and others have a terminal tuft of even four or more ramuli of different lengths. This plant grows on rocks, but its most frequent place of growth is on the shells of the Balani or sea-acorns. Its colour is a dull brownish purple. Favellidia, containing a globular mass of spores, are produced within the marginal filaments of the frond. This species is annual. It is widely dispersed, but nowhere very abundant. *Helminthocladia* (formerly *Nemaleon*) *purpurea*, is a rare deep-water plant, though occasionally found growing at extreme low-water mark, but of stunted form and sparingly branched. Specimens from deep water are from 12in. to over 2ft. in length. The main stem is tapered at both ends, and is set on each side with branches of similar form, which are irregularly and sparingly provided with ramuli. Instances, however, occur, of very luxuriant forms of this species, and in such, the stem and branches are very thick, round, and soft to the touch, and are plentifully, but always irregularly, set with ramuli of various lengths. Two lateral branches from a large deep-water specimen are represented at Fig. 133, a third less than the natural size. The colour of this plant in the living state is a rich reddish purple, and, under the microscope, as Dr. Harvey has so beautifully said, in describing its structure, "the axis of the stem is composed of colourless, branching,

FIG. 133. *Helminthocladia purpurea.*

longitudinal threads, and the apical cells of the horizontal filaments, which are thrown out on all sides to the circumference, cause the stems and branches of this plant to appear as if studded with red beads set in transparent glass." Round masses of spores are concealed within these radiating filaments. This fine species is a summer annual. It occurs

FIG. 134. Branch of *Helminthora divaricata*.

FIG. 135. *Scinaia furcellata*.

in the west of Ireland, but I have taken it only on the south Devonshire coast. *Helminthora* (formerly *Dudresnaia*), *divaricata*, is a summer annual, which, in opposition to some writers, I must pronounce to be a rarity. It is widely distributed in northern latitudes, and occurs on some of the south coasts of England. I have taken it nowhere but in Whiting Bay, Isle of Arran, and there I met with it two seasons in succession. Fig. 134 represents a slightly enlarged branch of this species. The fronds, which are from 6in. to 14in. high, are tufted and densely branched, and set throughout with short, curved, and divaricating ramuli. The substance is very soft and gelatinous. The colour is a brownish purple, and the structure, under the microscope, is as remarkable and beautiful as that of the foregoing species. Little masses of purple spores are concealed among the tufted filaments that radiate from the centre of the stems and branches. *Scinaia* (formerly *Ginannia*) *furcellata*, is a summer annual that is cast ashore in the south of England, some seasons rather abundantly. The fronds are from 3in. to 6in. high, and are branched by repeated forkings, the tips regularly ending in a little fork, whence the specific name. Fig. 135 represents a branch of this species. The stem and branches are cylindrical, and are of a soft pulpy substance. Under the microscope, the fibrous axis of the plant appears almost like a midrib, from which slender, forked, horizontal filaments radiate towards the margin of the frond, within which, and at the tips of the radiating branched threads, the spores are produced, being, in fact, a transformation of the terminal cells of those filaments. Tetraspores, which have recently been discovered by me in Torbay specimens, are immersed in the surface cells of the fronds. The colour is a bright red, which, with care in the mounting and pressing of this plant, is retained in drying. All the species of this very gelatinous tribe of plants require particular treatment in preparing them as specimens for the herbarium. The best plan is, after having washed them well in sea-water, and freed them from parasites, to display them on paper in the usual way, in a dish of sea-water; then place the papers containing them in an inclined position for a few minutes, so that the water may drain away; then lay them upon one of the boards of the press, and gently place the muslin or calico covering over the plants, then the blotting paper over the calico, and a similar piece of blotter under the paper on which the plant is displayed. On the top of all place a board, but apply no pressure. Experience alone will direct the length of time the plants should be allowed to remain thus, but my advice is to change the blotting paper at least twice during the first half hour, and then, after the second change of blotters, apply very gentle pressure for a few hours, after which, change the blotting papers once more, and increase the pressure somewhat for a day, and finally give stronger pressure for a day or two, when, upon releasing the plants, the manipulator will be fully rewarded for his patience and industry.

The Order *Wrangeliaceæ* consists of two genera, which were formerly placed in two widely separated divisions, but owing to the difference of

structure in the spore-bearing organs of these algæ to that of the groups with which they were originally associated, and their agreement in general structure with each other, they are now included in an Order which was named by Professor Agardh in honour of Baron von Wrangel, a Swedish naturalist. Fig. 136 represents a branch of the beautiful species, *Wrangelia multifida*. It is usually found on the shaded sides of deep rock-pools near low-water mark. It is rare in Scotland, but more or less abundant during the summer months on the west coast of Ireland, and is generally taken in fine condition from June to the end of August, near Plymouth and elsewhere on the coast of Devon. The plant is from 6in. to 10in. high, but I have taken specimens at Bovisand Bay, below the Plymouth Breakwater, which were over 2ft. in circumference. The fronds are tufted and densely branched, the stems and branches are composed of

FIG. 136. (*a*) Branch of *Wrangelia multifida*. (*b*) Portion of stem and branchlet magnified.

single jointed tubes, and each articulation bears, just below the joint, a whorled tuft of multifid, incurved, branched ramuli. The joints of the stems and branches are many times longer than broad, and they are all marked in the centre with a broad siphon filled with crimson endochrome. The spores are contained in favellæ, which are inclosed in what is termed an "involucre," and these are produced on stalks which arise from amidst the whorls of little ramuli; and it is curious that specimens which produce this form of fruit, present a stunted, scrubby appearance, as though they were old, or out of condition; whereas barren plants, or those in tetrasporic fruit, are much larger, the branches are clothed luxuriantly with crowded secondary branches and branchlets, well supplied with bushy tufts of ramuli, and the colour is a brilliant rose-

red. The tetraspores are seated on the upper side of the joints of the whorled ramuli. A variety of *Wrangelia*, called "*pilifera*," is found

FIG. 137. Branch of *Naccaria Wiggii*.

in Plymouth and in Torbay; the chief difference being in the much greater length of the ramuli, which appear as though they were drawn

FIG. 138. Portion of stem and branch of *Naccaria Wiggii* (magnified), with *fruited ramuli*.

out into long tendrils, most of which are simple or very slightly branched. This plant is extremely difficult to figure satisfactorily, but it is hoped

that the slightly enlarged branch in our illustration, in addition to the magnified portion of the stem and branchlet beside it, will help students in the identification of this beautiful species, when they may fortunately meet with it. The delicate and extremely rare Rhodosperm, *Naccaria Wiggii*, was named in honour of Naccari, an Italian botanist, and specifically, in compliment to Mr. Wigg, of Norfolk, who discovered it. Fig. 137 represents a branch of this species, which is one of the rarest of our marine algæ. It is a summer annual, and is found chiefly along the south coast of England. The fronds are from 4in. to 10in. long, and are excessively branched. The stem and branches are solid but flaccid, and the whole plant is so soft and gelatinous to the touch that it requires the most skilful management and patience to display its beautiful branching fronds effectually. It adheres closely to paper, but pressure must be applied very gradually, or the soft gelatinous fronds will stick to the calico, and tear off upon its removal. The stems and branches of this plant are abundantly set with very minute ramuli, which taper at each end; and in the centre of these the fructification is produced, which causes them to swell and become somewhat spindle-shaped. This is well seen in the representation of a magnified portion of a stem and branch at Fig. 138. The granular appearance on the surface of the ramuli indicates the sporiferous nucleus within. The colour is a fine rose-red, which is destroyed by the slightest contact with fresh water. There is a variety of this species known as *N. hypnoides*, which is extremely rare. It differs from the typical form, chiefly in certain peculiarities of structure which are only appreciable under careful microscopical examination, a course with which few of my readers are likely to trouble themselves.

The brief description I have given of the *Wrangeliaceæ* concludes my account of the British seaweeds which are included in the first series or subdivision of Rhodosperms, called *Desmiospermeæ*.

The second great series of red seaweeds contains the lesser organised families, and these are included under the title *Gongylospermeæ*, or plants whose sporiferous nuclei, or spore-bearing organs, contain numerous spores congregated without order in each nucleus, or seed receptacle. First in this series is placed the order *Rhodymeniaceæ*. The plants of this Order are characterised as purplish or blood-red seaweeds, with an inarticulate, membranaceous, or sometimes filiform frond. The root is generally disc-like, sometimes branched, and occasionally very much matted. The leafy expansions of the frond are seldom symmetrical, the sole exception being that of *Maugeria* (*Delesseria*) *sanguinea*, which is also the only species possessing a distinct midrib. The plants of this Order are widely dispersed, representatives of most of our genera being found in various parts of the globe. Some of the plants of this group are among the best of our edible seaweeds. The well-known *Rhodymenia palmata*, called "Dulse" in Scotland, and "Dillisk" in Ireland, is collected on all parts of the coasts, including those of the northern English counties, and is even carried to the markets of country towns, where it is sold and eaten with

FIG. 139. *Rhodymenia palmata.*

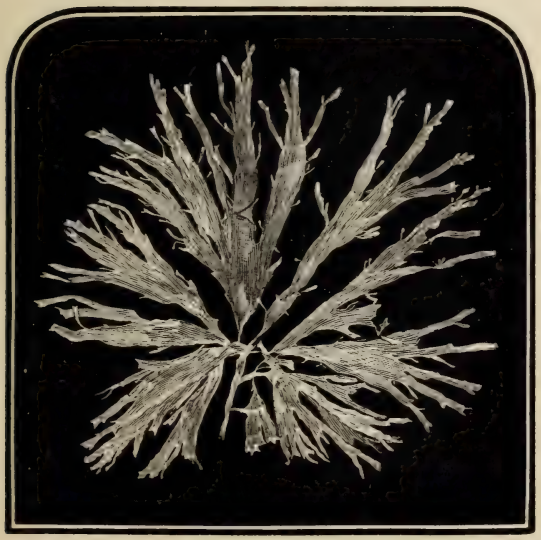


FIG. 140. *Rhodymenia palmata*—VAR. *sobolifera.*

potatoes, sometimes being boiled, but in many places eaten raw, just as it is gathered fresh from the sea. Cattle and sheep are especially fond of it, and the latter always eat it with avidity whenever they find their way to the rocks where it grows, or is cast ashore. The genus *Rhodymenia*, as formerly described by Dr. Harvey, contained many beautiful species which Professor Agardh has recently transferred to other genera, and now it is represented in Britain by two species only. *Maugeria sanguinea* having been already described, I direct the reader's attention to Fig. 139, which represents the characteristic deep-water form of *Rhodymenia palmata*. There are several varieties of this common plant found on our shores; some are attached to rocks, or parasitical on the shore *Fuci* and the stems of the *Laminariæ*. In the Mediterranean it has long been extensively used in *ragoûts* and many other simple dishes, and Dr. Harvey described it as being the chief ingredient in a soup recommended to the Irish peasantry by the celebrated Soyer. The fronds of this species are from 3in. to 2ft. long, very irregularly divided, the typical form being more or less palmate or hand-shaped, the margins of all the divisions being entire, the bases of the frondlets or branches always tapered, and the tips invariably obtuse or rounded. The colour varies from a dull brown-red to a deep red, turning to a pale yellow, or sometimes a greenish tint in decay. Tetraspores are scattered in cloudy patches over the whole frond. Although this species sports in such a variety of forms, there are four recognised varieties, which may be described as follows :—Variety *Marginifera*, the frond of which is fringed all along its margin with a series of leaflets of various lengths; var. *Simplex*, in which the frond is a long wedge-shaped, undivided leaf; var. *Sarniensis*, the frond being laciniated

FIG. 141. *Rhodymenia palmetta.*

or cleft into a tuft of long, narrow segments; and var. *Sobolifera*, the most distinct and characteristic variety of the species, very well represented at Fig. 140. The frond arises from a short stem, and soon expands upwards into irregularly cleft wedge-shaped branches, laciniated and very much jagged at the margins and tips. This particular form I have in-

variably found growing on the long stems of *Laminaria digitata* (Fig. 46). *Rhodymenia palmetta* (Fig. 141) is a rarer and very much smaller plant. It rarely exceeds 2in. or 3in. in height and breadth. Its pretty little fronds are usually fan-shaped, and are divided rather numerously by repeated forkings, which are rounded at their axils, the tips being pointed

FIG. 142. *Rhodymenia palmetta*—var. *Nicœnsis.*

or tapered. The stem is long in some specimens, but very short in others. Tubercles are borne near the tips of the segments or sometimes on their margins. Tetraspores are also produced in the terminal forks, and appear like little cloudy spots within the margins. This form of the species is usually parasitic on the stems of *Laminaria digitata* (Fig. 46). It is annual, and is found from May to August. The very pretty and distinct var. *Nicœnsis* (Fig. 142) I have always found growing on rocks at extreme low-water mark. Our illustration was taken from a very perfect specimen found by me outside the Castle rocks at Hastings. In this species the fronds are tufted, and arise from a narrow horny stem; the forkings are few, and the segments are cleft nearly to the base, each division being long, narrow, and rounded at the tips. The substance is at first very rigid, but it becomes soft and pliable in drying, and adheres very well to paper. The colour is brighter than that of the former plant, being of a beautiful rose-pink. The plant is a summer annual, and, like the foregoing, is widely distributed, but is usually considered a rarity, its diminutive size doubtless causing it to be frequently overlooked. *Euthora cristata*, which was formerly a *Rhodymenia*, is an extremely rare summer annual, found only on the northern coasts of this country, but pretty generally on the Scottish shores and at the Orkneys. This beautiful little plant, so rare in England, is one of the commonest species in America, where it is frequently found producing both kinds of fruit; the tubercles being, however, generally observed on the upper margins of those with broad segments, tetraspores on specimens with narrow crested branches. Both of these forms of the species are represented at Fig. 143, the narrow variety being slightly enlarged. The fronds of this species are about 2in. high. Those of the narrow variety are usually divided into

FIG. 143. Two varieties of *Euthora cristata*.

FIG. 144. Two varieties of *Rhodophyllis bifida*. *(a)*. Form producing tetraspores. *(b)*. Luxuriant but barren plant.

two or three principal sections, with very crowded branches, which expand in a fan-like manner, and are prettily crested at the tips. The colour is a fine rose red, that of the tubercles is much darker and the plant when young generally adheres very well to paper.

Rhodophyllis (formerly *Rhodymenia*) *bifida*, is a rare summer annual, which grows on rocks in the sea, but is usually a deep-water plant, hence the difficulty in obtaining specimens in good condition. It is found on most of the British shores, though rather rarely in Scotland. The fronds are tufted and very densely branched. In barren specimens the segments are usually wide and not so deeply cleft at the margins and tips as those which produce fruit. The tubercles are globular, and are either seated on the margins or are sometimes dispersed over the surface of the upper divisions of the frond. Tetraspores are produced in little cloud-like

FIG. 145. *Plocamium coccineum.*

spots within the margins, or scattered near the tips of the upper lobes. Fig. 144 represents the two varieties I have just described. Var. *ciliata*, as described by Dr. Harvey, is now raised to the rank of a species, under the name of *Rhodophyllis appendiculata*. The margins of the frond of this plant are fringed with little leaf-like processes or cilia, and in these the tetraspores are placed. The colour of these plants is a fine pink or rose-red; and although when taken from the water they are like bunches of crisp leaves, they soon become soft and flaccid, and adhere very well to paper.

The genus *Plocamium* is represented by some of its species or varieties in both hemispheres. Our own beautiful and well-known *Plocamium coccineum*, dear to amateur algologists and seaweed picture makers, is well represented at Fig. 145. This is the commonest and certainly one

of the most elegant of the branching series of British algæ. It is also one of the easiest to display on paper; its fine shrub-like branches being tolerably flat, and presenting few difficulties in arranging, even to the most inexperienced manipulator. The fronds arise from a fibrous root, and are from 3in. to 12in. high. They are very much branched and bushy, but vary greatly in the size and breadth of stem and ramuli, according to the depth of water in which they grow. Their beautiful little compound or comb-like ramuli, on specimens found in shallow rock pools, are so fine and closely set, that, without recourse to a magnifier, I have often known collectors mistake such plants for *Callithamnia*; but specimens which are cast up from deep water have broad flat stems, even in the second and third series of branches; the numerous sets of awl-shaped ramuli which are set in rows like the teeth of a comb, chiefly on the inner face of the branchlets, are distinctly apparent even to the naked eye, and, when once known, serve to distinguish this favourite species at a glance. The colour of this plant is generally a bright red, and specimens may be mounted equally well in sea or fresh water; in fact, I have picked up plants on the shore after a heavy shower of rain, that were of the deepest crimson; but on exposure to strong sunlight for any length of time, the fronds become perfectly white or colourless. The capsules of *Plocamium* are about the size of small poppy-seed, and are seated on the sides of the upper branchlets. Tetraspores are contained in little star-like receptacles called "stichidia," which are seated on the inner face of the ramuli; but as they are strictly microscopic a strong lens is necessary even to detect them. One of these branched receptacles is represented at Fig. 146. The tetraspores are scattered near the tips of the terminal divisions.

The genus *Cordylecladia* is represented on the British shores by the solitary species *Cordylecladia erecta*, a complete plant of which is represented the natural size at Fig. 147. This rare little alga was formerly included in the genus *Gracilaria*. Its new name signifies "chord," or "string-like branch." The fronds, which are tufted and very sparingly branched, grow up from a disc-like base, which is usually so imbedded in sand that the upper portions only of the little erect stems are visible; and this peculiarity of habitat, in connexion with the small size of the plant, may probably account for its rarity; for although it is widely distributed along the shores of the British Islands, specimens are by no means abundant, either in public or private collections. The fronds are rarely over 2in. high; the plant grows in rock pools, is perennial, and fruits in winter. The capsules of this species are very prominent, and are produced, more or less abundantly, in clusters, or on each side of the upper parts of the stems and branches, as seen in our illustration. The colour is a dull red, the substance is stiff and rigid, and the plant does not readily adhere to paper; therefore when specimens are dried, I recommend an application, to the under side of the stems, of the mixture made from isinglass dissolved in spirits of wine.

The *Cryptoneniaceæ* are an extensive Order of plants, which may be

characterised as purplish or rose-red seaweeds, with a stringlike, or sometimes expanded, and occasionally somewhat leafy, frond, having roots generally discoid, but in some instances clasping or creeping fibres. This Order is the largest and most widely dispersed of the Rhodosperms, species

Fig. 146. Stichidium of *Plocamium*, highly magnified.

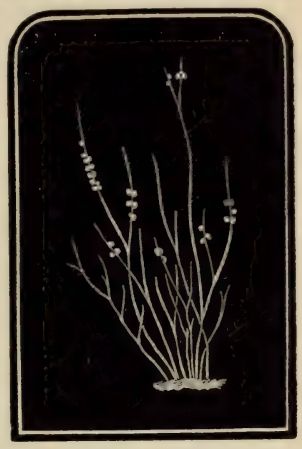


Fig. 147. *Cordylecladia erecta.*

of many of the genera being found on the Atlantic shores of both hemispheres, in the Mediterranean, and in the Indian oceans. Some species are found on the north-west coast of America, and others are abundant in the Southern Ocean, while one species at least, which is so rare in this country, viz., *Gigartina Teedii* (Fig. 160), is considered quite a common plant on the south European shores, where it is frequently found in fruit—a fact which has never been recorded of specimens taken in Britain. Several of the *Cryptonemiaceæ* might be used as articles of food; the well-known Carrageen moss, formerly used medicinally in consumptive cases, is composed of two species, *Chondrus crispus* (Fig. 162) and *Gigartina mamillosa* (Fig. 161), both of which may be boiled down to a jelly, and when mixed with milk or meal makes a far more wholesome article of food than indifferent potatoes or other vegetables; and that pretty membranous plant, *Iridæa edulis*, as indeed its specific name implies, is by no means an indifferent esculent, in spite of what some writers have said to the contrary, for the flavour when cooked, is, as I have found, remarkably like roasted oysters. The title of this Order is derived from the characteristic form and situation of the Favellidia of most of these plants; each favellidium consisting of masses of spores which are developed within the substance of the frond, or, as Dr. Harvey says, "either wholly concealed beneath the surface cells, or their place is indicated by a minute

pore through which the spores are finally liberated." Fig. 148 represents a frond of the beautiful and very rare species, *Stenogramma interrupta*. The fronds of this plant arise from a small discoid root. The stem, which is very short, soon expands into a broad, fan-shaped branching membrane; the segments are flat and cleft, somewhat in the manner of those of *Rhodymenia palmetta* (Fig. 143), but the colour is much brighter and richer, being a deep rose-red, especially so when the plant is in fruit, and then it is impossible to mistake this brilliant species for anything else. The narrow line or nerve which traverses the segments of the frond, but broken or interrupted here and there by a short space, is thickened about the centre, and is of a brilliant crimson. These swollen portions of the nerve contain the conceptacles, which at maturity are filled with a vast number of very minute spores. Fig. 148 (*b*) represents a vertical cutting of a conceptacle, the spore mass within raising the upper and depressing the under surface of the central portion of the segment, the inner stratum being composed of large colourless cells, the rich red endochrome being confined to the external layers of small cells on each surface of the frond. This rare plant is annual; it is taken in Cork Harbour; at Minehead, in Somerset; and washed ashore in several situations near Plymouth. Usually, British specimens are from 2in. to 5in. long, but I have dredged some in Plymouth Sound, which were over 8in. long, and several of the divisions which had been injured at the tips had thrown out

Fig. 148. (*a*) *Stenogramma interrupta*; (*b*) Vertical cutting of conceptacle magnified.

a new series of segments from the broken parts, all of which were branched in the same manner as the primary frond. This curious plant is found on the Californian and Spanish coasts, and at New Zealand. It was formerly called *Delesseria interrupta* by the elder Agardh; but its more recent name

is very characteristic, as having reference to the narrow nerve or line in the centre of the laciniations, which is interrupted at short intervals just below the forkings of each segment.

. The genus *Phyllophora* has also a very appropriate name, which signifies "leaf-bearers," in reference to the leaf-like membranes which by proliferous growth are thrown out from the apices and surfaces of the segments below them ; and in luxuriant specimens this system of branching, or leaf-bearing, is sometimes repeated by a continuous series of simple or branching leafy lobes, especially in the largest and most common species, *Phyllophora rubens*, very well represented at Fig. 149. The fine plant from which this illustration was taken, I found in Whitsand Bay, near Plymouth. The colour was a fine rich crimson, and the expanded fronds described a circle

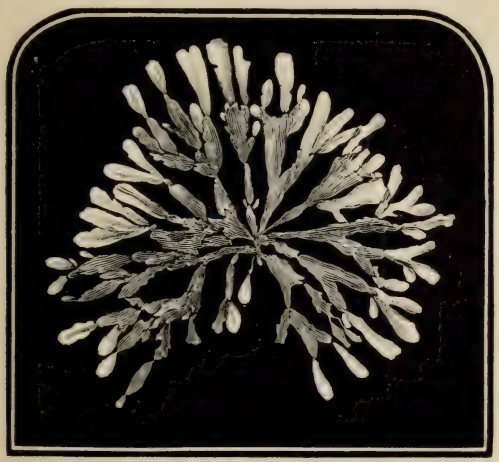


FIG. 149. *Phyllophora rubens.*

of 2ft. 6in. The spores in this species are contained in scattered tubercles and also in nemathecia, warty excrescences on the surface of the frond, which are composed of strings of jointed filaments, some of the joints of which are sometimes converted into spores. Tetraspores are placed in small leafy processes or collected in patches, called " sori," near the tips of the fronds. *P. rubens* is perennial and fruits in winter. It is common on the southern shores of England and Ireland, but is rare in Scotland. *P. Brodiæi* is, however, abundant on the eastern coast of Scotland, but rare in England. The typical form of this species has a more distinctly cylindrical stem than the foregoing, and the upper divisions and segments of the frond are narrower and fewer, though produced on the same principle. The colour is rarely so brilliant as in *P. rubens*, and the plant

seldom attains the dimensions of that species. Fig. 150, represents a beautiful form of this species, described by Dr. Harvey as *P. Brodiæi*, var. *simplex*, the fronds of which have stems about 1¼in. long, expanding into beautiful rose-coloured lobes twice or thrice forked, but not usually producing another series of segments. This variety is very rare. The plant from which our illustration was taken, was gathered by me in Torbay this summer (1873). The fronds were about 2in. in length, the colour of the stems was a dark brownish-red, that of the leafy portions, brown-red tipped with rose-pink. *P. palmettoides* (Fig. 151 *a*) is the smallest and the rarest of this genus. The fronds, which are numerous, arise from a broad fleshy disc. The stem is short and filiform or string-like, about an inch high, terminating in a simple or rarely more than once divided leafy expansion of a cuneate or wedge-shaped form. These little fronds sometimes throw out tiny leaflets from their tips or their surfaces. Tetraspores are the only form of fructification I have observed on this species, and they are contained in transverse sori in the form of an ellipse near the tips of the fronds. I took this pretty little species once only, many years ago, in the neighbourhood of Plymouth; this season a very pretty form of the plant has been taken on the Meadfoot rocks, near Torquay, by Mr. and Mrs. Josiah Field. This rare little plant bears a very strong resemblance to the early state of *P. Brodiæi*, from which it may generally be distinguished by the much greater expansion of its discoid base, the stems being more distinctly separated from each other, and the leafy parts of the fronds being a more decided rose colour, that of *P. Brodiæi* being brown-red or inclining to purple. *P. membranifolia*, Fig 151 *b*, is much more frequently met with than either of the two species just described. The fronds vary from 6in. to 10in. high; the stem is filiform or even stick-like, but the branches suddenly expand into prettily fan-shaped forked or cloven frondlets, which sometimes, but rarely, bear a second series of segments. The tubercles of this species are borne on little stalks thrown out from the upper side of the branches. Nemathecia, which are frequently produced, occupy the principal inner surface of the frondlets; they are of a darker tint than the plant, and are of angular form, similar in fact to that of the division or frondlet in which they occur. I have taken this species at Shanklin, in Torbay, and at Plymouth. It is like the rest of this genus, perennial, and fruits in the autumn and winter. Most of the species are troublesome to mount on paper, as they are apt to shrink in drying and are often very much encrusted with zoophytes or some of the calcareous algæ. These annoyances are easily scraped away while the plants are still in the mounting dish, and when they are partially dried, they may be re-floated and mounted on fresh paper, when, with good pressing, they will adhere tolerably well; if not, a slight application of dissolved isinglass to the under side of the loose or rigid parts will secure them permanently.

The genus *Gymnogongrus*, from the Greek, signifying "exposed wart-like excrescence," in reference particularly to the fructification of one of these

FIG. 150. *Phyllophora Brodiæi*—var. *simplex*.

FIG. 151. (*a*) *Phyllophora palmettoides*. (*b*) *P. Membranifolia*.

plants, contains only two species which are found in Britain. Fig. 152 represents a very characteristic frond of *Gymnogongrus Griffithsiæ*, bearing several gongri or nemathecia. These curious bodies are composed entirely

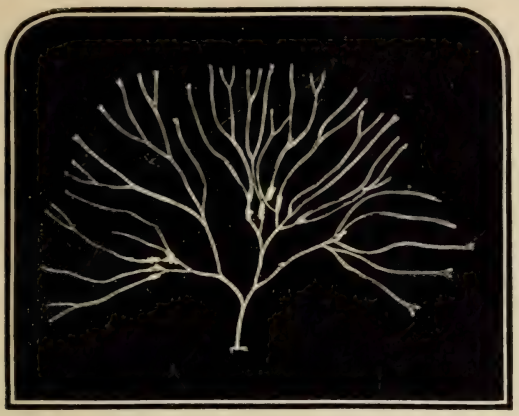


FIG. 152. *Gymnogongrus Griffithsiæ.*

of necklace-like strings of tetraspores, which in the living state under the microscope are as brilliant as tiny rubies, and each tetraspore is faintly marked with a cross, hence the term "cruciate," as applied to tetraspores

FIG. 153. *Gymnogongrus Norvegicus.*

so divided. The fronds of this little plant are tufted, and each has a distinct stem about half an inch long, which suddenly branches out into a slender but densely entangled frond, dichotomous or forked, the axi

rounded, each division terminating either in a lengthened branchlet or a fork, the tips of all being obtuse or rounded, the whole plant being of nearly uniform thickness throughout. This species is perennial, and fruits in the autumn. It is found in various situations from the Orkneys to the South of England and in Ireland.

The companion species to *Gymnogongrus Griffithsiæ*, *G. Norvegicus*, Fig. 153 (formerly *Chondrus Norvegicus*) is very frequently mistaken for narrow forms of *Chondrus crispus* (Fig. 162), from which it may be distinguished by its thinner substance and by the axils of the forked divisions, which are less rounded than in *Chondrus*, and, also, the segments of its fronds seldom vary much in length and breadth; the stem also is more cylindrical and the fronds are more regularly dichotomous. Our illustration, like that of the foregoing species, was drawn from the plant the natural size. The fronds in each are about 2in. or 3in. high, and more or less tufted. Favellidia of small size are sometimes found, imbedded in the frond, but nemathecia are more frequent. These are scattered over the frond, and, like those of *G. Griffithsiæ*, are composed of beautiful filaments like strings of minute jewels. The colour of this plant is a full rich red. Though originally found in Norway, and specifically named "*Norvegicus*," it is abundant during the spring and summer at Brighton and all along the coast to Devon and Cornwall. It occurs also in Ireland and in some parts of Scotland. Both of these species are troublesome in displaying and mounting, but directions for manipulation in such cases have already been copiously given. *Ahnfeltia* (formerly *Gymnogongrus*) *plicata*, Fig. 154, is probably one of the least attractive of the Rhodosperms to the ordinary collector. The fronds, which are from 3in. to 10in. ong, are very slender, wiry, and excessively entangled, often infested with parasites, which, although disfiguring the specimen, assist somewhat in attaching the rigid branches of this species to paper. Once having mounted a specimen of this uninviting plant, the student will never fail to distinguish it, even by the touch, for there is no other seaweed with fronds so stiff, wire-like, and horny. I have found it in various parts of England and in Scotland, but its characters are the same everywhere. The fructification consists of wart-like masses encircling the stems; and once only I have met with a specimen which bore capsular fruit, the little spore vessels being sessile or stalkless, attached to the side of the branches somewhat like the tubercles on *Gracilaria confervoides* (Fig. 127). The colour is a brownish purple, but owing to the extreme tenuity of the fronds, which are hardly thicker than a hog's bristles, this plant appears almost black when freshly gathered, but it turns a yellowish or waxy white in decay or by exposure to sunlight.

Fig. 155 represents the terminal portion of a branch of *Cystoclonium purpurascens*, better known by its former generic name of *Hypnæa*. This is a very common plant on most of the British shores. The fronds vary from 6in. to 2ft. in length; the main stem, which rises from a fibrous root, is bare for an inch or two, and then it is thickly set on each side with

wide-spreading branches, which throw out several series of similar lesser branches bearing ramuli more or less abundant, luxuriant specimens being excessively bushy and very difficult to display on paper without a con-

FIG. 154. *Ahnfeltia plicata.*

siderable amount of pruning. Tubercles containing spores are produced in the ramuli, solitary, or in pairs one above the other; tetraspores are imbedded in the branchlets, as represented in our illustration. The colour

FIG. 155. *Cystoclonium purpurascens.*

of this species is very variable; in early growth it is a reddish purple, but on exposure for a day or two it turns a pale yellow, and in drying, it shrinks and becomes a dull red purple, or sometimes nearly black, and

does not always adhere very satisfactorily to paper. There is a variety of this plant sometimes met with, called "*cirrhosa*," the branches of which are long and less bushy, the terminal portions being prolonged into little curled processes, somewhat like the tendrils of a creeper, by means of which the branches of this variety are occasionally found attached to other plants.

To those of my readers who have not followed the numerous changes which have taken place in the systematic arrangement and nomenclature in the science of algology, it will doubtless be matter of surprise to find so many familiar plants described in these pages under new and very different names. Several of these have been already disposed of, but I have yet to speak of many others. About five-and-twenty years ago Dr. Harvey, in describing the natural character of the plants included in the old genus *Rhodymenia*, observed, "This is an ill-defined genus, and will probably be eventually broken up into several;" and most literally have his words been verified, for of the various species which originally constituted this fine group of plants, many have been scattered far and wide, and among those which have been so treated is the splendid alga represented by a fruited branch at Fig. 156, formerly *Rhodymenia*, but now *Callophyllis laciniata*. This handsome species, rather than *Rhodymenia palmata* (Fig. 139), was probably in the mind's eye of the poet when he wrote of its crimson leaves being like "a banner bathed in slaughter;" for although he calls it "dulse," which is the common name for *Rhodymenia palmata*, the fronds of this species can scarcely be called crimson, while those of *Callophyllis* are always so. The fronds of this species arise from a small disc, and are from 3in. to 12in. long. The stem is very short, and the fine membranous fronds soon expand into more or less numerously forked segments, most of which are rounded or sometimes laciniated at the tips. Tubercles are borne in little leafy processes which fringe the margin of the segments, as represented in our illustration. Tetraspores are contained in dark patches along the margins, and I have occasionally found specimens with spots of tetraspores thickly scattered over the whole surface of the frond. This plant is widely distributed. I have taken it in fine condition, in fruit as well as in the barren state, in Torbay and around Plymouth; and one season, near Tynemouth, on the splendid sands at Whitley, the shore was red for upwards of a mile with multitudes of specimens of this superb Rhodosperm. It is biennial, and fruits in winter. Some specimens do not adhere very well to paper, and are also apt to contract the surface; when this is the case, the plant should be dried in the ordinary manner, and when it has ceased to shrink, the specimen must be floated over again and mounted on another piece of paper, when, if after drying and pressing once more it fail to adhere, it must be refloated in milk, but the blotting papers should be changed once after a quarter of an hour's pressure, and then strong pressure must be applied for a day or two, after which the plant will remain permanently fixed to the paper.

Kallymenia reniformis, Fig. 157, when grown in favourable situations

is a very showy plant, and though rare, is found in various localities from the Orkney Islands to the south coast of Devon; where, particularly at

FIG. 156. *Callophyllis laciniata.*

Plymouth, I have gathered magnificent specimens, the kidney-shaped lobes of some being over 4in. wide and 6in. long. The frond of this species arises from a tiny stem, and is either solitary or produced in

FIG. 157. *Kallymenia reniformis.*

groups of various dimensions thrown out from the margin of the stem. The substance is thick and fleshy and the colour is usually a deep rich red,

sometimes in decay being tinted with shades of yellow and green. Favellidia, or masses of spores, but of small size, are scattered over the frond; tetraspores, which are still more minute, are imbedded in its substance. The species *microphylla*, so named from the small size of its membranous lobes, might easily be mistaken for the young state of the foregoing, but the different position and arrangement of its conceptacles are considered of sufficient value to constitute this plant as a species distinct from *K. reniformis*. I have never seen this plant in fruit, but in Dr. Gray's "Handbook of British Waterweeds" the conceptacles are described as "emerging from one side of the frond only, nearly flat above."

The genus *Gigartina*, from the Greek for "grapestone," which the tubercles of these plants strongly resemble, contains several species which the uninitiated collector frequently finds extremely difficult to mount on paper, chiefly on account of their horny or cartilaginous nature, some being filiform or stringlike, others compressed or flat. *G. pistillata*, very well represented by a fruited branch at Fig. 158, has been very aptly compared by Dr. Harvey to "a bunch of raisins, from which the fruit has been removed, leaving the pedicels only." This species is very rare in this country. I have taken it nowhere but in Whitsand Bay, but there I had the good fortune, many years ago, to meet with specimens bearing tubercles (as in our illustration) and others producing tetraspores. The former are very conspicuous; the latter are contained in slightly swollen portions of the branches. The root is a fleshy disc, the fronds are tufted, and more or less branched, forked, and sparingly furnished with ramuli, which are usually simple, but sometimes pinnated or winged, the tips of all being acute or pointed. The colour is a dark reddish purple, which turns nearly black in drying. *G. acicularis*, or the needle-pointed *Gigartina* (Fig. 159), though less rare, is by no means abundant. It occurs in Ireland, and on the Cornish coast. I have taken it in Torbay, on one occasion with tubercles produced on the smaller branches; but fruit on this species, is, I believe, very rarely found. The tufted fronds of this species are often very prettily arched, and are set, though sparingly, with simple, alternate wide-spreading branches, some of which produce a second series, or are merely secund, which signifies the production of branchlets or ramuli on one side only. The form of the expanded plant is somewhat rounded but inclining to a pyramid in outline. The tips of all the branches and ramuli are invariably acute, a character which gives the specific name and assists the collector in recognising the plant. The colour is similar to that of the foregoing. *G. Teedii* (Fig. 160) is taken from a branch or two of a specimen gathered by Mrs. Griffiths at Elberry Cove, in Torbay, thirty years ago. This plant, I presume, must be considered one of our greatest rarities. I have examined every nook and crevice in every accessible rock pool in Torbay for three consecutive seasons without meeting with a scrap of this species. I have never met with it in the growing state, but I do not despair of finding it some day in or near its old habitat in Torbay, although I strongly suspect it has receded further from the shore than formerly, and

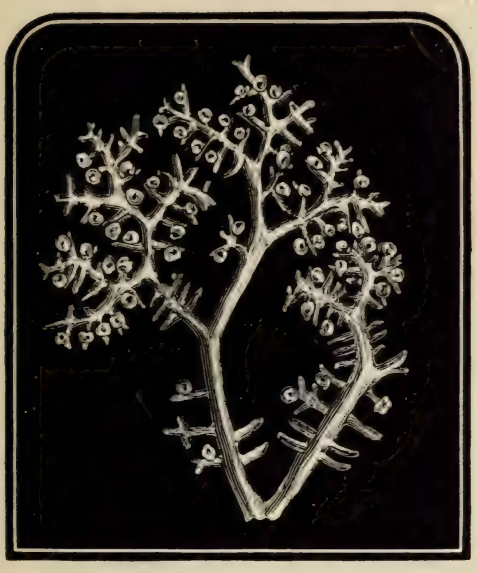


FIG. 158. *Gigartina pistillata.*

FIG. 159. *Gigartina acicularis.*

will now be obtained only by dredging. The colour of this rare plant is much more decidedly inclined to a reddish tint than any of the others of this genus, and, like all the rest, it adheres very imperfectly in drying.

FIG. 160. *Gigartina Teedii.*

G. mamillosa is the common species of this group; Fig. 161 represents a frond of this plant. It is generally found in company with *Chondrus crispus* (Fig. 162), and forms with that species the carrageen or Irish moss of the

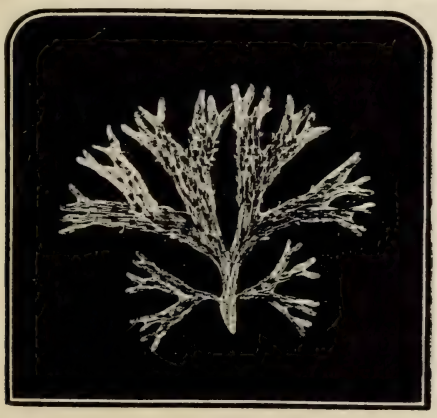


FIG. 161. *Gigartina mamillosa.*

druggists' shops. The fronds are tufted and are of various dimensions; they are all more or less covered with mamillæ or little tongue-like processes, which arise from the margins and broad surfaces of the upper

divisions of the forked segments. When the plant is in fruit the spores are produced in these mamillæ or leaflets, which are sometimes so abundant that the manipulator is sorely puzzled in mounting his specimens effectively. The colour of this species is a dark purple, but the plant is so frequently exposed to strong sunlight, that luxuriant specimens are often met with in the growing state, exhibiting tints of olive, dark brown, black, and, sometimes, even a decided shade of green. The fronds rarely exceed 4in. in length. The species is perennial and is found pretty generally throughout the year on almost all rocky shores.

Chondrus crispus (Fig. 162) is one of the commonest and most variable in form of all the native British seaweeds. The French writer, Lamouroux, figures no less than thirty-six different varieties. On our own shores the size of the fronds and the breadth of the segments seem to me to depend very much on the situation in which the plant is found growing. The larger and broader forms are generally met with near high-water mark, and particularly so where the plants are exposed to the influence of a fresh-water stream, while at low-water mark, or in deep rock pools, the fronds, although produced in large bushy tufts, are generally extremely narrow throughout. Our illustration represents two widely different forms of this species, both being considerably reduced in size ; *a*, is from a finely grown plant with broad spreading lobes, somewhat like those of *Phyllophora Brodiæi* (Fig. 150) ; *b*, is from a plant with narrow segments ; the tuft from which these fronds were taken grew outside a rock where it was exposed to the swill and dash of the waves. All the forms of this thick cartilaginous species may be easily distinguished. The fronds arise from a crisp discoid base, having at first a narrow cylindrical stem, which gradually flattens and increases in breadth, from which very suddenly the lobed segments are produced, most of which are repeatedly forked, the axils of all being invariably and distinctly rounded. The tips are obtuse or truncated, besides being what is termed emarginate, which means depressed at the margin here and there, rather than cloven, and one side or other of all the divisions, is constantly crisped or inclined to curl round, a peculiarity which is referred to in the specific name. The fructification consists of prominent tubercles, which not only emit their spores at maturity, but fall away from the plant, leaving round hollow spaces in the frond ; sori or groups of tetraspores are immersed in the fleshy substance of the plant, and favellidia are also sometimes found ; these consist of masses of minute spores which are imbedded in the frond, but are different in structure to the tubercles, or, more properly speaking, nemathecia, which rot, or at least, drop off the fronds at maturity. The colour of this species is as variable as its forms are numerous ; but in shady rock pools, where it is occasionally visited by gleams of sunlight, the fronds exhibit a mixture of dark red and purple, and the margins and tips of the divisions are, at times, beautifully iridescent. As the plant advances towards high-water mark, its colours are more sombre, being generally a dull brownish-red, or sometimes olive-green, and in

FIG. 162. Two varieties of *Chondrus crispus*.

FIG. 163. (*a*) *Chylocladia clavellosa*; (*b*) Branchlet with capsules magnified.

decay or when cast ashore, it is often bleached white, or turns to a pale yellow.

The two plants which I shall now describe, formed, until recently, the only members of the genus *Chrysymenia*; both, however, have been emoved to *Chylocladia*, and now, according to Professor Agardh's most recent arrangement, they are the only British representatives of the old genus *Chylocladia*. The name of the genus, which signifies "juicy branch," is very applicable to these soft red seaweeds, which are so flaccid and tender, that with very little care they are easily displayed, and after gentle and gradually applied pressure, they adhere most perfectly to paper. *Chylocladia clavellosa*, the larger and more abundant of the two, is represented at Fig. 163. It is the upper half of a most beautiful specimen taken in Torbay, where it is cast ashore every summer. This lovely annual is found on all the British coasts, but is most abundant and of larger size on the south coast of Devon than elsewhere. I once found a specimen on the shore near Exmouth, fully 2ft. long. The fronds are usually from 4in. to 14in. in height. The main stem is very thin at the base, but it gradually thickens upwards and tapers off at the apex to a fine point. The branches are numerous and closely set on each side of the stem, and are clothed with one or two series of similarly arranged branchlets or ramuli, which are lanceolate or tapered at their insertion and at the tips. Thus each lateral branch is a kind of repetition, in a limited degree, of the order of growth of the whole plant. Instances occur in which the branching is excessively crowded, and in these the ultimate ramuli spring from all sides of the stems and branches. Conceptacles, somewhat conical in form, are seated on the upper branches: their form and position are represented in the magnified branchlet at *b*, Fig. 163. Tetraspores, which are microscopic, are immersed in the little club-shaped ramuli or terminal branchlets. The colour is a rosy red, often a brilliant pink, turning a golden yellow in decay: and it was owing to the constant tendency of this species to assume the latter tint that the name *Chrysymenia*, or golden membrane, was originally given to it by Mr. Dawson Turner. The pretty little plant represented at Fig. 164 was discovered at Skaill (Orkney), and named by Dr. Harvey *Chrysymenia Orcadensis*. It was afterwards found at Filey, and many years later by Dr. Cocks and myself on some of the mooring buoys in Plymouth Harbour, and still more recently by Mr. John Gatcombe in the same locality. My own northern specimens are, however, finer and better grown plants than any I ever met with in the south of England. The main stems of this little species are about 2in. high, tapered at each extremity, but very broad in proportion to their length. They are furnished with several pairs of pinnæ or wing-like branches of similar form, but much shorter and narrower, and some of these branchlets throw out occasionally a solitary tiny ramulus. In some of the Plymouth plants I have observed that the branches were narrow and very much attenuated; but I believe this to be truly a northern species, and although it is found rather abundantly some seasons in the south, such forms of

the plant are, but waifs and strays from their original home in the north. I have never seen this species in capsular fruit, but tetraspores I have often observed. They are imbedded throughout the whole length of the little elliptical branchlets and ramuli. The colour is a rose pink ; the

FIG. 164. *Chylocladia rosea.*

interior of the frond is filled with a colourless watery juice, so that in preparing the plant for the herbarium, care must be observed in pressure, or the specimen will be destroyed or disfigured.

Of all the red plants that have come under my notice during many seasons of seaweed gathering, I know of no species so variable in form and

FIG. 165. (*a*) *Halymenia ligulata*, var. *dichotoma*; (*b*) *H. ligulata*, var. *latifolia*.

ramification as the soft gelatinous plant named *Halymenia ligulata*, or the strap-shaped sea-membrane, for that is what its botanical name literally signifies. The numerous forms of this curious species are, however, as Dr.

Harvey observes, "resolvable into three distinct varieties." The first of these, *Dichotoma*, is very well represented at *a*, Fig. 165. The fronds are from 4in. to 8in. long, with two or three principal divisions of variable width; these are more or less forked with apparently laciniated or jagged segments, and here and there throughout the plant, numerous little branchlets and ramuli shoot forth, some from the margins, and others from the surface or other parts of the frond, giving to this singular species a strangely wild and irregular appearance. The second variety is termed *Ramentacea;* in this the frond is from 10in. to 15in. long, divided into three or more principal branches, tapered at the base, then swelling out into broad thick lobes, and generally attenuated towards the tips. The third variety is described as *Latifolia*, very well represented at *b*, Fig. 165. The plant from which this illustration was taken was gathered at Plymouth many years ago, and was entirely destitute of branchlets or ramuli.

Fig. 166. Branch of *Furcellaria fastigiata.*

The tip is forked, and a short distance below there is the apparent attempt to throw out a branch or a broad segment; otherwise this specimen is the nearest approach to a perfectly simple or unbranched frond of this species that I have ever met with. The length of this plant was 14in., that of the branched specimen beside it very little less. The fruit is contained in favellidia, or masses of spores, which are concealed beneath the periphery or external coat of the frond, and are attached to the inner surface of the outer stratum of cells. These curious plants are always found in fruit, the favellidia being easily distinguishable through the periphery, and appearing little dark red spots scattered all over the surface of the fronds. The colour is usually a rose pink, the plant is a summer annual, and is found most frequently on the southern shores of England and Ireland, and in the Channel Islands.

At the commencement of my list of the Rhodosperms, I described a plant named *Polyides lumbricalis* (Fig. 83), which, in outward form and when

Fig. 167. *Grateloupia filicina.*

not in fruit, is so remarkably similar to the species I am about to speak of, that points of difference are at times scarcely distinguishable. The plant I refer to is *Furcellaria fastigiata*, represented by a branch or two at Fig. 166. The little fastigiate forks which terminate the branchlets are, when the plant is in fruit, swollen in the centre, and gradually tapered to a point. In these lanceolate receptacles masses of tetraspores are produced, but at maturity all these pod-like bodies fall off, leaving the forked branches truncate or jagged at the tips. The fronds arise from an entangled fibrous root, and are about 10in. or 12in. high, each having

Fig. 168. *Schizymenia edulis.*

a stem an inch or two in length, and then branching upwards dichotomously, the divisions being all forked and fastigiate, or terminating in

acute tips, presenting like *Polyides*, when spread out on paper, a perfectly rounded outline. This plant, which is a very dark red, turns quite black and horny in drying, and requires great care and patience in making it a presentable book specimen. It is abundant all round our coasts, is perennial, and fruits in winter.

The genus *Grateloupia*, dedicated to M. Grateloup, a French naturalist, is represented on our shores by one species only, *G. filicina*, or the fern-like *Grateloupia*, a pretty specimen of which is represented at Fig. 167. In outward appearance this species has a strong resemblance to the variety *flexuosum* of *Gelidium corneum*, but its structure and system of fructification are widely different. Favellidia are concealed beneath moniliform or necklace-like filaments, of which the outer stratum of the frond is composed; tetraspores are placed among the peripheric filaments of the lateral branchlets. The fronds are tufted, each having a main stem about 3in. high, tapered at each extremity, and set on each side with alternate or opposite series of flexuous branches, some of which occasionally put forth a second set of branchlets or ramuli, all of which are attenuated at the base, and drawn out to a sharp point at the tips. This species is rare in Britain, but it is met with in several situations, chiefly on the south and west coasts. It is perennial, and fruits during the winter months. The colour is dull red, but specimens which grow where a freshwater stream runs into the sea, turn a pale fawn colour in the upper branches, as though they were bleached in the sun.

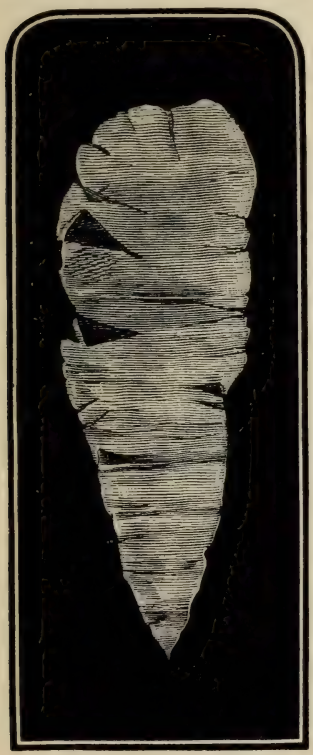


FIG. 169. *Schizymenia Dubyi.*

Under the generic name of *Schizymenia*, signifying "cloven membrane," are now included two plants, each of which until recently, were in separate and very differently constituted genera. The first of these, formerly *Iridæa*, is now *Schizymenia edulis*. Fig. 168 represents a group of very perfect young fronds. They arise from a firm expanded disc, and are from 3in. to 20in. long, of a fleshy or somewhat leathery substance, having a very short round stem, which gradually flattens and

expands into a broad, obovate, perfectly smooth lamina or plate-like leaf, undivided (except by accidental laceration, or the inward force of growth), and beautifully rounded at the top. The ordinary place of growth is in shady rock pools, where frequently the fronds are beautifully iridescent. I have found this species on all parts of the English coasts; at Plymouth, in Torbay, and on the shores of Durham and Northumberland, all equally fine and presenting precisely the same characters. The colour is a deep blood-red; it is in perfection from early summer to the end of autumn, and fruits during winter. Spores are collected in immersed favellidia near the terminal portion of the frond; tetraspores are also produced in the substance of the plant just within the external cellular stratum. *S. Dubyi*, dedicated to M. Duby, was formerly *Kallymenia Dubyi*. Fig. 169 represents a mature frond of this fine species; the plant from which our illustration was taken is one of the finest specimens I ever met with; it was over 14in. high. The frond is always undivided, except by accident or the force of the waves, but the margin is sometimes waved or curled, though otherwise perfectly smooth and entire. The root is a small disc, and the base of the leafy frond is wedge-shaped, the tip being usually rounded. It is a summer annual, and is met with in fine condition in the Falmouth Harbour, in the sheltered bays near Plymouth, and in the west of Ireland. This species I have never found growing in tufts, the frond is always, I believe, solitary, even when several specimens are met with growing near each other in the same locality. The colour is a brownish red; favellidia of small size are scattered abundantly over the surface of the plant.

The genus *Catenella* contains a few species of very tiny plants, one of them only being found in Britain, known as *Catenella opuntia*. Fig. 170 *a*, represents a plant of the natural size, and *b*, some of its little branched filaments highly magnified. The fronds are scarcely more than 1in. high; they arise from creeping fibrous roots, and are densely interwoven, every portion of the plant being composed of little strings or chains of elliptical joints, whence the name, which is from the Latin for a little chain. This diminutive plant is generally considered rare, but its small size doubtless causes it to be frequently overlooked. I have, however, found it once only in the south of England; but I have received it from collectors near Filey, who obtain it there often very abundantly. The spores are contained in capsules attached to the upper articulations of the frond, tetraspores are immersed in the ramuli; the colour is a dull purple, turning blackish in drying.

Gloiosiphonia capillaris, represented by a few branches at *a*, Fig. 171, is one of the rarest and most beautiful of the British red filiform algæ. This plant is very difficult to display nicely on paper; the stem and principal branches are tubular, but soft and gelatinous, as expressed in the generic name; the branchlets and ramuli, although capillary or hair-like, are so juicy and flaccid that in drying they press upon each other and clot together, so that it is extremely difficult to make a

FIG. 170. (*a*) *Catenella opuntia*; (*b*) Branches from the same, slightly magnified.

FIG. 171. (*a*) Branch of *Gloiosiphonia capillaris*; (*b*) Branchlet from the same magnified.

satisfactory figure of any portion of this beautiful species. It is a summer annual and is very rare, though found in many parts of Britain, and in numbers of situations on all the Atlantic shores. My own finest specimens were taken years ago near Plymouth. Some of the main stems of these were 14in. high, and clothed on each side throughout their whole length with closely set bushy branches, gradually getting shorter as they approach the apex of the stem, which terminates in a point, the whole plant having very much the appearance of a larch fir in miniature. The spores are produced in small red globular masses imbedded in the marginal filaments

FIG. 172. (*a*) *Dumontia filiformis*; (*b*) Magnified section of the frond, with Favellidia.

of the frond; tetraspores are placed in the branchlets, one of which is represented, magnified, at *b*, Fig. 171. The colour is a fine rose pink, the stems turning a pale yellow in drying.

Fig. 172 represents a group of young fronds of *Dumontia filiformis*, the branches of the central frond being intentionally shortened. This is another of our native species named in honour of a French *savant*, by name Mons. Dumont. The fronds of this common annual grow in tufts of three or more, tapered at the base, and gradually thickened upwards for an inch or two, then suddenly furnished with long, alternate, round, filiform branches, attenuated at each end, generally simple, but occasionally

divided or once forked. This plant is extremely variable in the length and number of its fronds. Near high-water mark or in shallow pools, a single frond, or at most two or three, grow on the rocks, or are attached to limpet shells, about 3in. high, and of a pale brownish-red colour; while in shady rock pools, or as it approaches low-water mark, the fronds are densely tufted, are often over 16in. long, and of a dark reddish purple. There is a curious variety of this species called *crispata*, in which the fronds are flattened and very much curled or twisted. This form of the plant is found only in the neighbourhood of fresh-water streams, and is another of those peculiarities observable in some species of seaweeds, where their character, form, or colour, is merely *altered* by contact with fresh water, while with many others, and particularly so with nearly all the species of the Order *Ceramiaceæ*, destruction or disfigurement is the immediate result. The stem and branches of *Dumontia* are at first tubular but solid, the internal portion being composed of loosely intertwining filaments; but as the plant reaches maturity these filaments are absorbed, leaving the tubular stems and principal branches empty within. Favellæ, or round clusters of spores are produced within these tubes and attached to their sides, being formed out of the cells of which the inner surface of the tubes are composed. *b*, Fig. 172, represents a portion of the tubular stem of *Dumontia*, highly magnified, showing favellæ attached to the inner wall of the tube. This peculiar production of the fruit in *Dumontia* serves to illustrate the characteristic title of this extensive Order, that of *Cryptonemiaceæ*, the spore-bearing organs being concealed or hidden within the substance of the frond.

The curious plant, *Spyridia filamentosa*, was formerly included in the Order *Ceramiaceæ*, but it now forms the only British representative of the very small Order *Spyridiaceæ*; the name being from the Greek for a basket, in allusion to the form of the favellæ of these plants. Fig. 173, *a*, represents a terminal portion of a branch of *Spyridia filamentosa*. I have met with this species in Torbay and in the neighbourhood of Plymouth, but on no other part of the British coasts. Most of the species of this small group of seaweeds are natives of warm climates, our own *S. filamentosa* being widely distributed; very abundant on the American shores, frequent in the Channel Islands, and reaching, I believe, its northern limit on the southern shores of England. The fronds of this plant are from 3in. to 10in. high. They arise in bushy tufts from a discoid root, and are very irregularly branched, the main stems being of a densely cellular substance, and very obscurely jointed. The lateral branches are mostly short, but, like the main stems, are beset on all sides with short bristle or hair-like, mostly simple, but jointed scattered ramuli. The favellæ, which consist of two or three masses of spores, are produced on a ramulus which is somewhat altered in form, being divided from the tip downwards, and thus constituting a trifid or quadrifid involucre, within which the roundish masses of spores are seated, as represented at *b*, Fig. 173, which is a highly-magnified portion of stem, branch, and

ramuli, a bi-lobed favella being suspended from a trifid ramulus. Tetraspores, when present, are attached to the sides of these little ramuli; they are very minute, roundish, and produced in twos or threes, and sometimes in clusters. The colour of the living plant is a pinky red, turning a pale reddish brown in drying. It is said to be perennial, and is in perfection from July to September.

The beautiful and extensive Order *Ceramiaceæ* contains many of the most delicate and attractive of the British red seaweeds. The structure, even in the most compound forms of these plants, is exceedingly simple, being for the most part strings of cylindrical cells, more or less branched, the little cells or joints each growing out from the tip of the one below it, the branches being formed by cells arising, or budding,

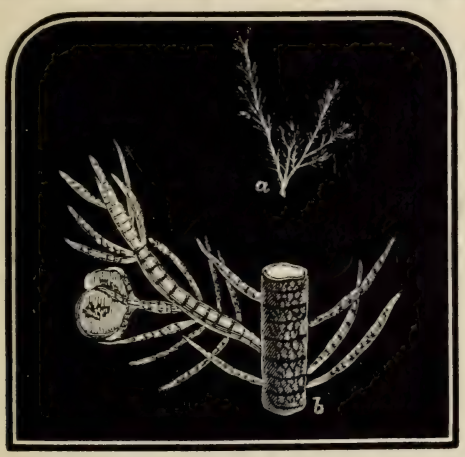


FIG. 173. (*a*) Terminal branch of *Spyridia filamentosa*; (*b*) Portion of the same with bi-lobed favella, magnified.

as it were, from the upper sides of the mature or previously formed articulations. In the larger and more compound forms, the stems and some of the principal branches are coated or supplied internally with closely packed longitudinal filaments, which traverse the fronds and render those portions of the plants nearly opaque; but even in these apparently more highly organised structures, a very slight examination will reveal the original articulated filament, which is the characteristic structure of most of the species of this interesting tribe of marine algæ.

The name of this Order is from the Greek for a pitcher, in reference to the form of the fruit, which is much more characteristic of the *Ceramidia* of the *Polysiphoniæ* than of any of the spore-vessels of the *Ceramiaceæ*, which are berry-like, but not in any instance pitcher shaped. However,

until some recognised algological authority thinks proper to alter the name, and the botanical world acknowledges it, we must be content to retain what, in my humble opinion, is a misnomer for the Order, a description of which I am now entering upon.

Fig. 174, *a*, represents a complete plant, the natural size, of the rare and very pretty deep-water summer annual *Microcladia glandulosa*. This species was discovered by Mrs. Griffiths in Torbay in the early part of the present century, and has been found in several situations on the south coast of Devon, and on the east coast of Ireland. The plant from which our illustration was taken, was cast ashore near Plymouth, where I have taken it occasionally after storms, generally attached to the fibrous roots of some of the deep water algæ. The pretty little tufts of this plant are rarely more than 2in. high, and are generally of a roundish form, the tips of the branches always fastigiate, and either pointed or terminating in a little fork, the tips of which incline inwards, somewhat like the forcipate branches of *Ceramium rubrum* (Fig. 176), a species which is not unfrequently mistaken for this rare little rhodosperm. The fructification of this species forms an extremely interesting microscopic study. Two magnified branches are represented in Fig. 174; *b* is a terminal branch, on the margin of the central division of which is seated a favella, supported by two or three little finger-like ramuli, *c* is a branchlet which contains a series of tetraspores imbedded in the cells near the tip of the central fork. The fruit is rare, but is produced in autumn. The colour is a pale rose-red, and the plant adheres very well to paper. Very nearly related to this species, and also to some broad forms of *Ceramium rubrum*, is the plant which is represented by a branch at Fig. 175, an extremely rare and interesting species which I took many years ago, but have never met with since. The history of its discovery is as follows: In the summer of 1858, I was gathering seaweeds in company with the late Dr. Cocks, of Plymouth, when we found attached to the roots of a specimen of *Plocamium* a remarkable form of what I thought at the time was *Microcladia glandulosa*; but Dr. Cocks, not being satisfied with either his own or my opinion concerning it, forwarded the specimen to Dr. Harvey, who, after a careful examination of its structure, returned the plant, saying that "it was undoubtedly new, and must be regarded as intermediate between *Microcladia* and *Ceramium rubrum*, and that he proposed naming it *Ceramium microcladia Cocksii*." Favellæ were faintly apparent in some of the forked tips, a situation quite different from that in which they occur in either *Microcladia* or *Ceramium rubrum*. This particular plant is still in my possession. I have never met with another specimen of it, neither have I heard of any plant at all answering to its description having been taken until this season (1873), when a species of *ceramium* was sent to me from Plymouth, which certainly very closely resembles my former novelty, but, as it is not in fruit, I fear, after all, it must be referred to one of the broader forms of the protean *Ceramium rubrum*.

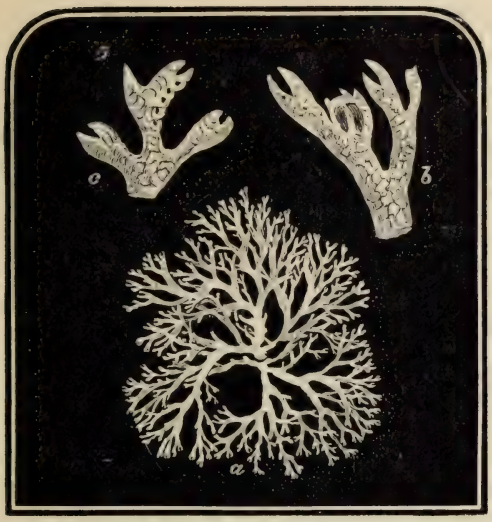


FIG. 174. *(a) Microcladia glandulosa; (b)* Branchlet with favella; *(c)* Branchlet with tetraspores, magnified.

FIG. 175. *Ceramium microcladia.*

The genus *Ceramium* comprises several well characterised species, several of which occasionally present varieties of form or structure which are more or less puzzling to the uninitiated. However, there are at least eleven British species which are now generally acknowledged, and as they represent the three sections into which this group was divided by Dr. Harvey, I shall describe them according to that characteristic arrangement.

The first section, *Rubra*, contains the well-known *Ceramium rubrum* and its varieties. So widely dispersed is this common species, that Dr. Harvey says, "it is met with almost wherever marine plants will grow, from high arctic to high antarctic latitudes." On our own shores this

FIG. 176. *Ceramium rubrum*, with favellæ, magnified.

plant assumes such a variety of forms (according to the nature of the locality or the depth of water in which it grows), as frequently to puzzle experienced botanists as well as young collectors of algæ; however, well-grown specimens, and particularly those which are in fruit, are easily recognized. Fig. 176 represents a branch of one of the forms of *Ceramium rubrum* slightly magnified, bearing involucrate favellæ. Although, like all the plants of this group, whose stems and branches, are regularly more or less chequered by alternate dark-coloured nodes or joints, and colourless dissepiments or inter-spaces, the nodes and dissepiments of *Ceramium rubrum*, and its varieties, are more or less coated with coloured cells, hence the name of the typical species. The

little round masses, called favellæ, which contain the spores of this plant, are produced on the sides of the lateral branchlets, and are supported, or partly embraced, as it were, by two or three short ramuli. In the living state, or before the plant is mounted on paper, these favellæ are seen to have a pellucid limbus or border, through which, under the microscope, a multitude of minute angular spores are distinctly visible. The colour of the plant is properly a clear red, but it is found often enough of a brownish tint, sometimes yellowish, and even of as dark a colour as *Polysiphonia nigrescens* (Fig. 102). Plants having the latter tint are of the common coarse variety which I have frequently taken at Brighton, growing among the fuci or rock-weeds about half-tide level, the fronds of which were often over 20in. long.

The tetraspores of this species, as in most of the *Ceramieæ*, are generally formed from the surface cellules, and are immersed in the articulations, but in some they project slightly above the surface, like little pimples. One of the most distinct varieties of this species, formerly *C. botryocarpum*, from the grape-like form of its clustered spore-vessels, is now known as *C. rubrum*, var. *proliferum*, the branches of which are beset on all sides with short simple or sparingly branched ramuli, the tips of which are straight or pointed, those of *C. rubrum* being slightly hooked inwards. Sometimes this variety produces globular favellæ; but its distinctive fruit vessels are the clustered masses which are borne on the lateral branchlets, but which are not accompanied by involucral or clasping ramuli. This, like most of the other species, is a summer annual. The colour is rarely so bright a red as that of the foregoing plant, but the whole surface of the fronds is coated with cellules, which are sometimes purplish, but often change to a greenish yellow.

The only other variety of *C. rubrum* which I think it necessary to describe is the plant which was figured by Dr. Harvey the under name of *C. decurrens*. It is now regarded by Professor Agardh as a variety of *C. rubrum*; it may be known by its slender fronds, which are much more sparingly branched, and by the presence of a narrow colourless space which occurs in the centre of the dissepiments or internodes, which is caused by the faint tint or even absence of coloured cellules. An ordinary lens will readily show the surface cells of these plants when they are gathered fresh from the sea; and in the absence of fruit, the presence of these cells in all parts of the stems and branches, afford the student a ready means of recognition, although, of course, it requires practice and experience to distinguish the numerous forms of this variable species. The only plant with which *C. botryocarpum* (or *proliferum*) is likely to be at first confounded, is the curious species *C. Deslongchampsii*, the fruit of which is very similar, being produced in clusters, and, like the favellæ of that species, equally destitute of involucral ramuli, as seen at *a*, Fig. 177. The colour of the joints of the stems and branches is, however, very different, being of a dark purple, nd the spaces between them are perfectly colourless; the tips of all

the branches and ramuli are pointed and not at all hooked in. The tetraspores of this species are produced in the dark coloured joints; and what is also very remarkable, they are sometimes found on the

FIG. 177. Ramuli showing favellæ of (*a*) *C. Deslongchampsii.* (*b*) *C. diaphanum.* (*c d*) *C. nodosum.*

same specimen which bears favellæ. This plant belongs to the section, *Diaphana*, which is beautifully represented by a slightly enlarged branch of the elegant species *C. diaphanum* at Fig. 178. All the stems and

FIG. 178. *Ceramium diaphanum.*

branches of this justly admired plant, are marked at regular intervals with fine pink or purplish red nodes, the colourless interspaces being of a delicate silvery texture, all of which become shorter and smaller as

they approach the tips of the branches and ramuli, which terminate in little thumb-and-finger-like hooks.

The branches are set throughout, more or less abundantly, with short, jointed, simple or forked ramuli, the tips of which are hooked inwards. Favellæ are produced at the tips of the ramuli and in the forks of the terminal branchlets, surrounded by a collar of tiny ramuli, as seen at *b*, Fig. 177. The beautiful tufted fronds of this species are usually from 3in. to 6in. long, but I have taken specimens in Bovisand Bay, many years ago, a foot in length, finely in fruit, and of the richest mixture of reddish purple and silver, the tints of which are as brilliant at this moment as the day on which I first mounted the plants. *C. nodosum*, now *C. tenuissimum*, is one of the finest and most delicate of the genus. Its slender filaments are finer than human hair and are of equal diameter throughout. The pellucid internodes of the stem are several times longer than broad, becoming gradually shorter upwards. The dark-coloured nodes are usually broader than the colourless spaces between them, and from the sides of these in some of the shorter ramuli, prominent tetraspores are produced, as seen at *c*, Fig. 177. Favellæ, as represented at *d*, are seated near the tips of the ramuli in an angle formed by the tip of the branchlet and a short accessory ramulus. The little erect tufts of this species are rarely more than 4in. long, and are of a delicate pinky colour. Nearly allied to this species is the exquisite little plant *C. fastigiatum*, the hair-like tufts of which are truly fastigiate or level-topped, the tips being all directed upwards and slightly curved inwards. The lower internodes are three or four times longer than broad, the upper ones very short. The colour of the nodes is a lovely rose tint. Favellæ of small size are produced from the sides of the terminal branchlets supported by a few very short ramuli. Fig. 179 represents a terminal branch of a filament, which is divided with such regularity, that each fork, even to the very tips, is an exact repetition of the one below it. This pretty species is somewhat rare, but I have taken it in Scotland and in several stations on the South Devonshire coast. *C. strictum* is another favourite species, abundant during early summer in Torbay and around the rocky bays at Plymouth. The fronds are densely tufted, the filaments capillary or hair-like, and excessively branched and interwoven. The nodes are a lovely purple, the inter-spaces shining like silver, and in the lower parts of the filaments several times longer than broad, but gradually shorter as they ascend upwards. The branches are set here and there with little accessory ramuli; and these as well as all the branches of the plant, terminate in a little hook, the tips of which incline inwards, and close upon each other like a tiny pair of sugar-nippers. Fig. 180 represents a terminal branch, the forks of which, like all the rest of the plant, are erect and straight, the angles of all being regularly acute. *C. gracillimum* is the smallest and most delicate of all the British *Ceramieæ*. Its tender and very flaccid threads are generally so crowded and entangled, that it is a trial of patience and skill to display them properly on paper.

FIG. 179. Branch of *Ceramium fastigiatum*.

FIG. 180. *Ceramium strictum*.

FIG. 181. *Ceramium gracillimum*.

FIG. 182. *Ceramium flabelligerum*.

This species is extremely rare, but is met with generally in muddy pools, attached to *Corallina officinalis* (Fig. 111) and other small algæ, between tide-marks. It is readily known by the great length of its colourless joints and the crimson or purple nodes, from which arise minute fan-shaped lateral branchlets, which adorn the main stems, and are repeatedly forked to the very tips. Fig. 181 represents one of the terminal branches. The favella of this species is a remarkable microscopic object. It consists of two lobes, of globular form, enclosed in a pellucid border, and partly surrounded by long forked ramuli. This lovely species is met with in several situations on the Devonshire coast and in the west of Ireland, but I have taken it only at Plymouth and in Torbay. The third section of this beautiful group of plants contains four species which are remarkable for their spinulose habit, the dissepiments or nodes of all being armed with spines or bristle-like hairs. Fig. 182 represents a magnified terminal branch of the species *C. flabelligerum*, so called from the flabellate or fan-like branching of its fronds, which are about 4in. high, and set with forked lateral branches, the tips being mostly acute, but occasionally terminating in a tiny fork, the apices of which are slightly curved inwards, as seen in our illustration. The articulations of the lower branches are twice as long as broad, but in the upper parts they are mostly equal in length and breadth, and are all armed on the outer and upper edge with a single three-jointed awl-shaped spine. The favellæ are three-lobed, and are produced in the forks of the branches. The whole plant is coated with coloured cellules, assuming, in consequence, some resemblance to varieties of *C. rubrum* (Fig. 176), but the presence of spines in this species is a constant character which at once distinguishes it. This plant is by no means common, but it is found in Torbay, at Plymouth, and elsewhere in England, and on some parts of the Irish coasts. *C. ciliatum*, beautifully represented at Fig. 183, by two terminal forked branches, grows on rocks and on the smaller algæ in tide-pools, forming dense tufts of a pale purplish tint, but prettily chequered with silvery-white joints; the nodes only, containing the coloured cellules, which are also set with a whorl of three-jointed prickles, as represented highly magnified at *a*, Fig. 184. The branches are repeatedly forked, the tips of the terminal ones having yet another tiny fork, the apices of which are strongly curved round and inwards; and even the joints of these, minute as they are, are all furnished with the characteristic prickles already described. *C. echionotum*, represented by some filaments of this species at Fig. 185, is so named from the manner in which the slender, single-jointed spines are set on all parts of the nodes, closely resembling the arrangement of those on the shell of the Echinus or Sea-urchin. A portion of the stem, highly magnified, is seen at *b*, Fig. 184. The growth and ramification of this species are not unlike those of the foregoing, but the stems and branches are generally more abundantly supplied with little forked lateral ramuli, and the colour is usually dark red. The favellæ are generally two-lobed, and are supported by a whorl of short in-curved

ramuli. *C. acanthonotum*, the last of this group, grows generally on exposed rocks, or on the fronds of other plants, near low-water mark, in dense dark purple tufts, from 3in. to 6in. high. The favella of this species is as round as a ball (as represented at *c*, Fig. 184), and is seated on a curved jointed ramulus, every articulation of which (like those of the stems and branches of the plant), is armed on the outer upper side, with a single three-jointed prickle. In this respect it somewhat resembles *C. flabelligerum* (Fig. 182), but the coloured cellules in this are confined to the nodes, and the inter-spaces are perfectly hyaline, or colourless. When properly displayed, this species, like each of the two foregoing plants, makes a very attractive book specimen; but most of these ciliated

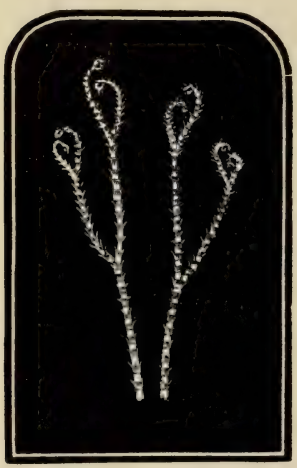


FIG. 183. *Ceramium ciliatum.*

FIG. 184. (*a*) Joint of *Ceramium ciliatum*; (*b*) *Ceramium echionotum*; (*c*) Three joints with ramulus and favella of *Ceramium acanthonotum.*

Ceramieæ are so entangled, by reason of their multitudinous spines, that the utmost patience and care are necessary to prevent the plants becoming an inextricable and unsightly mass.

The genus *Ptilota* contains two remarkably beautiful plants, one species being common on the northern and western shores of Great Britain, the other being found in almost equal abundance in the south of England, and on some parts of the north-eastern shores, in Scotland, and in the Isle of Man. Fig. 186 represents an enlarged branch of *Ptilota plumosa*, or the "plumed wing." The plant from which this was taken, was gathered by me in the Isle of Arran. It was growing on a huge specimen of *Laminaria digitata* (Fig. 46), encircling the stem of the great alga as with a feather-like collar of the richest brown-red colour. The fronds are from 4in. to 14in. long, and are beautifully and very copiously branched,

FIG. 185. *Ceramium echionotum.*

FIG. 186. *Ptilota plumosa.*

all the branches being set with an opposite series of spreading pinnules, which are closely pectinated, or set on each side with comb-like teeth, which gradually diminish in length towards the tips of the little branchlets. In luxuriant specimens the branches sometimes put forth a second and even a third series of branchlets, as seen in our illustration, and all of them are furnished with the pretty characteristic pectinated ramuli of this elegant species. Spores are contained in clusters of favellæ, which are produced within little stalked involucres, and these are mainly composed of several tiny clasping or incurved ramuli. These involucres are set along the stems of the ultimate branches alternately with the pectinated ramuli, and sometimes they are produced on the teeth of these little comb-like pinnules, as represented in the illustration. Tetraspores, which are very rare, are produced on the teeth of the ramuli. A very splendid form of this plant is abundant on the Australian shores, and another, equally beautiful, on the North American coasts. The specimens which are taken on the Irish coasts, and in the Isle of Man, have long lanceolate branches, with very short pinnules, and, although of very

Fig. 187. *Ptilota elegans.*

elegant growth and brilliant colour, are by no means so luxuriant and bushy as our North British specimens. This species does not readily adhere to paper. The fronds are very rigid, inarticulate, and of a more or less cartilaginous structure; but the branches being compressed, or of a very flat growth, they are easily displayed on paper, and with a little judicious pruning and the application of dissolved isinglass, they make some of the most attractive of our book specimens. *P. elegans* (Fig. 187), formerly *P. sericea*, is a much more delicate plant than the foregoing. The fronds are soft and silky to the touch; but they are usually so excessively and densely branched, that considerable pruning is necessary before a specimen can be effectively displayed. The manipulator is, however, well repaid for any amount of patience in arranging this plant, for it is assuredly one of the most beautiful of the British rhodosperms. Although the stems and principal branches are dark in colour, and of rather dense structure, the branchlets and pinnules are distinctly and beautifully jointed, as may be seen in Fig. 187, which represents two ultimate

branchlets, highly magnified, one of which bears bi-lobed favellæ at the tip, partly embraced by a few curved ramuli, the other produces tetraspores on the tips of the lateral cellules which project on each side from the large central cells of the pinnules. This species (like the former) is perennial, and is in perfection in summer. It grows on the sides of shady rocks near low-water mark. The colour is a dark brown-red, and the plant, being somewhat flaccid, adheres closely to paper in drying.

The genus *Dudresnaia*, dedicated to M. Dudresnay, a French naturalist, contains only one British species, *Dudresnaia coccinea*, represented at *a*, Fig. 188, by a couple of lateral branches. This curious but very beautiful plant is equally difficult to display effectively and to figure satisfactorily. Its delicate rose-red fronds are so tender and gelatinous, that they require several hours to drain off the paper on which they are laid out, before the calico and blotters can be placed on them, and the pressure applied; but with careful management they make the most exquisite specimens, for they retain their lovely rosy tints and adhere so firmly to the paper that it is impossible to remove them. This species is rare, being an inhabitant of deep water. I have taken it on the beach at Brighton, also in Torbay, and have dredged most beautiful specimens in Plymouth Sound. A microscopical examination of this plant reveals a beautiful structure. All the branches appear to be composed of articulated, slightly coloured, longitudinal filaments, which have disposed around them whorled tufts of rose-coloured branched fibres, extremely flaccid and of the utmost tenuity. In the water these dichotomons, or forked fibres, radiate around the stems; and when the plant is in fruit the branches appear as if studded with rubies, favellidia being borne at intervals among the whorled filaments; or tetraspores, when present, terminating a ramulus of the dichotomous fibres. A terminal branch, magnified, is represented at *b*, Fig. 188, showing the fruit among the whorled filaments; and *c* is a more highly magnified forked fibre, bearing a four-parted tetraspore, which is a transformation of its terminal cell. This charming plant is a summer annual, and is, I believe, peculiarly a southern species.

Crouania attenuata is an extremely rare, but remarkably beautiful plant, parasitical on *Cladostephus spongiosus*, and sometimes on *Corallina officinalis*. This also is a southern species. It is found on the Cornish coast near Penzance, and at the Land's End. I have taken it several times at Plymouth, but nowhere else. Its beauties are microscopic. Fig. 189 represents a branch of *Cladostephus* (one of the olive weeds), on the tips of which *Crouania attenuata* loves to dwell. The little tufts of this parasite are rarely over 2in. high. They are represented at *a*, Fig. 189, a quarter of the natural size; *b* is one of its forked branches highly magnified, and *c* is a portion more highly magnified, to show the dense tufts of multifid ramelli or branched filaments which are set around the stems and branches with the most perfect regularity. These little tufts are whorled round the joints of the stem, which is a syphon containing a broad tube, filled with dark red endochrome. Tetraspores are seated on these

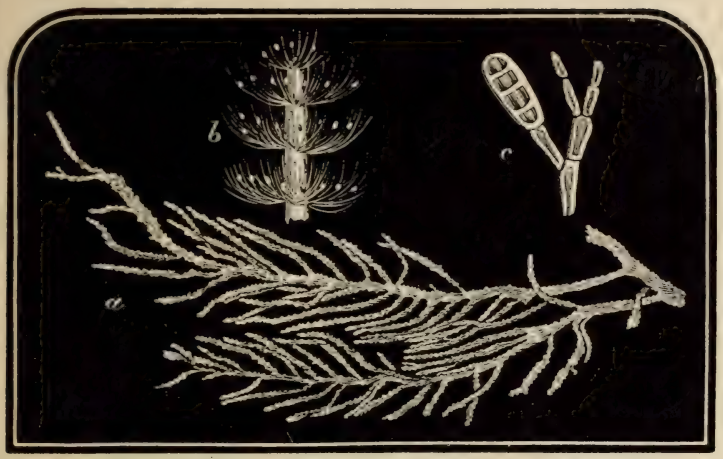


FIG. 188. *(a) Hudresnaia coccinea ; (b)* branchlet magnified ; *(c)* forked fibre, with tetraspore highly magnified.

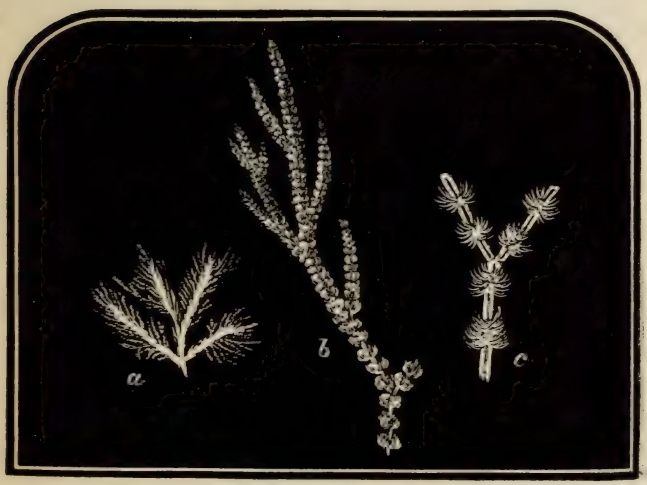


FIG. 189. *Crouania attenuata.*

tufted filaments. The name is in honour of two French algologists, the brothers Crouan, of Brest.

Halurus equisetifolius, better known by its former name, *Griffithsia equisetifolia*, is, in appearance (though not in colour), almost a counterpart of *Cladostephus spongiosus*. This curious plant was originally included in the genus *Griffithsia*. Its new name signifies "equisetum-like sea-tail," in reference to the whorled tufts of branched incurved ramuli, which are set with perfect regularity round the nodes of the stems and branches, in a very similar manner to those of the *Equisetæ*, or "horse-tails" of our lanes and meadows. The fronds of this plant are from 4in. to 1ft. in length; but only young plants, from 3in. to 5in. long, make good book specimens, owing to the robust growth and thickly tufted branches of this species, which turn a very dark or dirty brown in drying; otherwise, in early growth, the whorled ramuli of the young branches are a brilliant rose-red. Fig. 190. *a*. represents a terminal branch, somewhat enlarged,

FIG. 190. (*a*) *Halurus equisetifolius*; (*b*) *Griffithsia barbata*.

showing the order of growth of the whorled ramuli, and the stalked involucres containing favellæ, which arise from amidst the tufts. This species is taken very frequently on the south British shores. It is perennial, and is in perfection in summer. There is a beautiful variety of this plant, which formerly ranked as a distinct species, under the name *Halurus equisetifolius*, var. *simplicifilum*. One or two British localities have been recorded as habitats for this rarity, but I have never met with it on any of the British shores. The genus *Griffithsia*, named in honour of Mrs. Griffiths, of Torquay, is a large group of crimson, filiform, articulated algæ, the fronds of which consist chiefly of string-like branches of elongated transparent cells or joints, within each of which is contained a long bag-like ceil of brilliant red endochrome. The type of this beautiful genus is the plant known as *Griffithsia corallina* (Fig. 191), the fronds of

which, in the living state, when gathered fresh from the sea, glisten like strings of glass beads of the most lovely carmine or sometimes even a brilliant crimson. Fig. 191 represents an enlarged portion of a branch of this fine species. The fronds are tufted, and are repeatedly branched, the lower articulations being much longer than broad, the upper ones gradually shortening, giving to the terminal tufts of the plant the peculiar and distinctly beaded appearance which has suggested the specific name of *corallina*. This species is rather rare, but is taken in several situations on the south coast of Devon, in the Isle of Wight, and in the Channel Islands. The tetrasporic fruit is produced in whorls round the joints; favellæ are placed on the upper sides of the branchlets just below the joints, and are accompanied by a few short involucral ramuli. The colour of this delicate plant is so fugitive, that it is only possible to preserve even a vestige of its lovely tint by keeping it in sea water, and hidden from the light, until it is laid out on paper, and then pressure must be applied very gradually, or the beautiful coral-like structure of the joints of the stems and branches will be utterly destroyed. *Griffithsia setacea* (Fig. 192), or the bristle-pointed *Griffithsia*, is found on various parts of the British coasts, and is particularly fine in the Channel Islands. This species is perennial. Fig. 192 represents a fruited branch which I took this summer (1873) from a large plant of the species growing in a shaded rock pool in Torbay. The season before, the branches of this same plant were all barren. I watched the growth of this particular plant with the deepest interest, for it is usually an inhabitant of deep water, and I take this opportunity of recording what is certainly, I think, a very remarkable circumstance—viz., the presence of a deep-water species in a rock pool near high-water mark; luxuriant, yet barren, *one* season, and still more luxuriant, and producing fruit in abundance the following season. The fronds of this species are from 4in. to 8in. long, very rigid, erect, and bristle-like, each filament tapering to a fine point. The joints are cylindrical, and are several times longer than broad. The involucres containing tetraspores are produced on the sides of the branches, being, in fact, transformations of some of the lateral ramuli. They are suspended

FIG. 191. *Griffithsia corallina*, favellæ at the joints.

at the tips of these little branchlets, and, under the microscope, appear like little wicker baskets filled with crimson fruit. One of these is represented at *b*, highly magnified. This species (like all the others of this group) will not bear immersion in fresh water for an instant, for although rigid and crisp in its native element, fresh water has the power of causing the fronds to discharge their beautiful carmine colour, leaving nothing but empty cells or unsightly filaments tinged with yellow and green. *G. secundiflora*, so named from its peculiar system of branching, the ramuli or secondary branches being generally produced on one side only of the stems. This species has somewhat the appearance of the preceding, but its filaments are not so attenuated, and are blunt at the tips. The tufts are from 3in. to 6in. high. This is one of the rarest of our red seaweeds; it is tolerably abundant in the Channel Islands, but

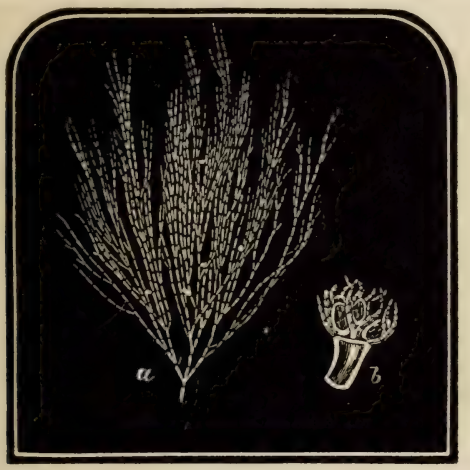


FIG. 192. (*a*) Branch of *Griffithsia setacea*; (*b*) involucre, magnified.

has not been found, so far as I know, in any other situation on the British shores, besides the sheltered bay at Bovisand, near Plymouth, where it was discovered by the Rev. Mr. Hore in 1846. It is reasonable to suppose that this beautiful *Griffithsia* is propagated by fruit, though all the specimens that I took at Bovisand were destitute of even the appearance of fructification; this leads me to conjecture that the plant produces its fruit during the month of December or January, during which periods its place of growth is altogether inaccessible, for even during the lowest spring tides it is submerged to a depth of 4ft. or more, and no boat could possibly approach the rocky nook where it grows except when the water was smooth or free from swell, which is very rarely the case during the winter months. The only fruited speci-

men I have ever seen of this rare species was brought from the south of Europe. Tetraspores are contained in little involucres, borne on short stalks, being transformations of lateral ramuli. The colour of this plant is a full rose-red, and the fronds adhere very well to paper in drying. *G. barbata* (Fig. 190) is another very rare species, which has been taken some seasons at Weymouth, and found occasionally by myself on the beach at Brighton. In the rock pools at Jersey it is found very frequently; the pretty tufted fronds being about 3in. high, and of a lovely rose colour; but none of the specimens taken by me on the Brighton shore exceeded 2in. in length, and as they were usually wave-worn before they were picked up and mounted, their delicate filaments were more or less faded, and only some vestiges of colour remained in the terminal branches. Fig. 190, *b*, represents the upper portion of a branch highly magnified, showing the beautiful elongated cells of the stem and the whorled ramelli which are set around the joints, on the inner faces of which, near the stem, are seated the oval or globular tetraspores. These tufts of multifid ramelli are very similar to the byssoid fibres on some of the *Polysiphoniæ*, and their beard-like character, in the plant before us, has suggested the specific name of *barbata*. This is the smallest and most attenuated of all the *Griffithsiæ*. It is sometimes mistaken for a *Callithamnion*, but the joints of its stems and branches (which are six or eight times as long as broad), in addition to the whorled tufts of jointed ramelli, all of which are distinctly apparent, even under an ordinary lens, are characters sufficiently definite to distinguish it at once. One of the most graceful of this elegant tribe of red seaweeds, is the very rare species *G. Devoniensis*, which was discovered by the Rev. Mr. Hore, at Plymouth, in 1840. This justly admired plant grows in muddy places rarely uncovered by the tide, even at low water. I never failed to find it during the summer, cast up on the mud banks opposite the Devonport dockyards. I also dredged it, or rather scraped it up in quantity by means of a long rake (taken by my boatman for the purpose) outside the banks of Beggar's Island, near the mouth of St. Germain's River. On one occasion, upon finding a specimen in splendid colour and fully in fruit, and well knowing the evanescent nature of its lovely rose-red tint, I washed the plant over the side of the boat, fixed it on glass, and covered it up from the light as soon as possible, and sailed back to my quarters at Plymouth with that peculiar feeling of satisfaction which few but enthusiastic naturalists can appreciate. The filaments of this plant are about 3in. high, densely tufted, very slender, forked and fastigiate, or pointing upwards. The joints are cylindrical, and many times longer than broad. Tetraspores are produced in involucres, which are whorled round the branches at the dissepiments or junction of the articulations. This is a peculiarity which serves to distinguish it from *G. setacea* (Fig. 192), which it otherwise very strongly resembles. The filaments are much more flaccid than those of *G. setacea*, and are therefore rather difficult to mount easily in a natural position. Care must be taken always to wash

and mount these delicate plants in sea-water, and to keep them from the light as much as possible until they are displayed and fixed on paper.

The genus *Seirospora* is represented in Britain by one species only, the beautiful *Seirospora Griffithsiana* (Fig. 193). The generic name, signifying "chain of seeds," very aptly characterises the fruitful cells, which are produced in strings or chains, being in fact, transformations of the terminal joints of the ultimate ramuli of the tufted fastigiate branches, as represented at Fig. 193; tetraspores, properly so-called, being also produced in strings, but scattered on various parts of the plant, and suspended on peduncles or short stalks. This charming species has all the appearance of a *Callithamnion*, and indeed Professor Agardh describes it under the name of *Callithamnion seirospermum*; however, the general opinion of algologists seems to be in favour of *Seirospora*, and as such, I am content to let it remain. The fronds are tufted, and have each a main stem from 3in. to 6in. high, set on each side with numerous

Fig. 193. Fruited branch of *Seirospora Griffithsiana*.

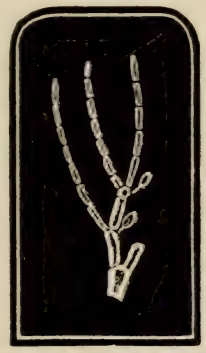


Fig. 194. Fruited branchlet of *Corynospora pedicellata*.

alternate spreading branches; the lowest of these are longest, and are more or less furnished with secondary branches and ramuli, the tips of which generally incline upwards, and in these the strings of fertile cells are borne, the contents of which are of a brilliant crimson, the stems and branches being of a pale pink, and at maturity becoming fainter, and even inclining to a shade of yellow or pale straw colour. The whole plant is extremely flaccid and tender, but adheres to paper very readily, and forms a most attractive book specimen. It is very rare, though found on various parts of the British coasts. The finest specimens in my possession were taken at Plymouth, and recently a magnificent specimen was sent for my inspection by Mr. John Gatcombe, who gathered it there.

The rare and beautiful alga now named *Corynospora pedicellata* (Fig. 194), was, until recently, included in the *Callithamnia*, but the peculiarity of its tetrasporic fruit has led to its removal, and now it forms the only British

representative of the genus *Corynospora*, a name which is characteristic of the somewhat club-shaped tetraspores of our species, as may be seen at Fig. 194, which is an enlarged terminal branch of *C. pedicellata*. The filaments of this plant are from 3in. to 10in. high, very tender and flaccid, irregularly branched, more or less divided, and set here and there with short forked ramuli, which are frequently produced in little rose-red tufts at the tips of the branches, the apices of all being invariably rounded. The articulations of the stems and branches are many times longer than broad, those of the ramuli being gradually shorter as they approach the tips. The tetraspores are produced on little stalks, which arise from the axils of the branches, or sometimes from the upper shoulder of the joints just below the terminal tufted ramuli. Their colour is much darker than any other part of the plant, and their form is either elliptical, or pear-shaped, or, as the generic name implies, club-shaped. Favellæ I have never seen, but they are described as being of large size, solitary or bi-lobed, and seated on the stems and larger branches. This species is a summer annual, and is taken at Brighton and Weymouth, in Torbay, at Plymouth, and in Whitsand bay.

I shall now enter on a description of the most interesting group of the British Floridiæ, the charming little *Callithamniæ*, or, as their generic name signifies, "beautiful shrubs;" attractive alike by the beauty and loveliness of their various tints, the delicacy and simplicity of their structure, and the exquisite grace and elegance of their forms. This beautiful genus contains nearly a hundred species, some twenty or five-and-twenty of which are found on the British shores. Some are tolerably robust, and attain a length of 6in. or 8in., while others are much smaller, and some are quite microscopic, forming minute velvety spots on rocks and on the stems and branches of other algæ. Their structure is exceedingly simple, all being composed of a more or less branched series of cells filled with pink or crimson endochrome, and placed end to end. The primary, or conceptacular fruit, is called a "favella;" it is a berry-like mass, usually produced on the branches, singly, in pairs, and sometimes in clusters. The secondary, or tetrasporic fruit, is generally scattered along the branchlets; in most cases the tetraspores are seated on the inner face of the joints or cells, and attached at their bases to the branchlets or ramuli on which they are seated. Many of the species are widely distributed; some are peculiar to the northern coasts, others are found only on the southern shores, while some few are met with in widely separated localities. The difficulty, not to say impossibility, of figuring most of these extremely attenuated plants, so as to convey any idea of their appearance in the living state, at least so far as to be of the slightest service in assisting inexperienced collectors in identifying species, compels me to have recourse to drawings of magnified portions of most of the plants I shall describe, and to impress once more on my readers the absolute necessity for the employment of the microscope, or the strongest lens obtainable, otherwise the distinction

of species in this very delicate group of seaweeds, is entirely out of the question. Dr. Harvey in his original description of the British *Callithamniæ*, classed them under six different characteristic sections, an arrangement which has always appeared to me so admirable, that notwithstanding the difficulty of arranging my illustrations in groups convenient for my purpose, I intend to follow the order of Dr. Harvey's arrangement in my descriptions of the species, as closely as possible. Section 1. *Cruciata*, contains all those species in which the ramuli are placed on the branches in pairs, generally exactly opposite to each other.

Callithamnion plumula is one of the most brilliant of this group. It is one of the commonest and most widely dispersed of the tribe, being

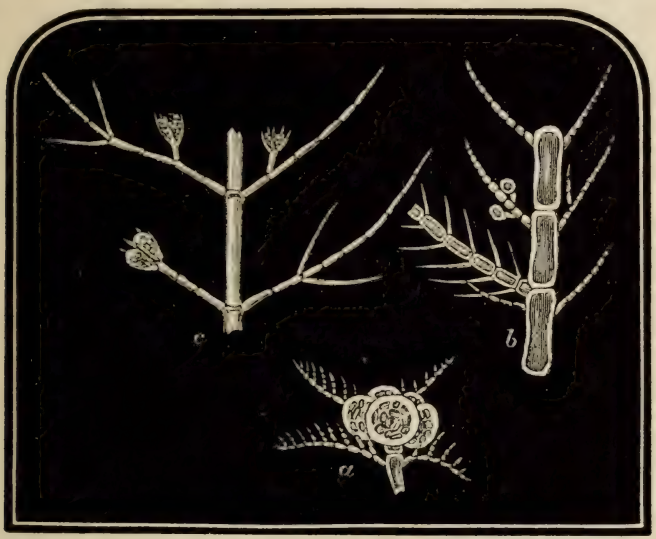


Fig. 195. (*a*) Favellæ of *Callithamnion plumula*; (*b*) *Callithamnion floccosum*; (*c*) *Callithamnion Turneri*, magnified.

found from the Orkneys to the South of Devon. The beauty and regularity of its growth, combined with its graceful outline, its branched fronds (which are like exquisitely arranged plumes of rose-tinted feathers), have long stamped this plant as a universal favourite. The order of growth in every part is very remarkable. Each branch and branchlet has its exact counterpart, and all the articulations throughout the plant bear each a similar pair of pectinated or comb-like branchlets. Tetraspores, like tiny glistening rubies, are seated on the upper side of the terminal ramuli. Favellæ, which are produced in clusters, are attached to the joints of the main branches, as represented at *a* (Fig. 195.) There is a

curious brownish-red variety of this *Callithamnion*, called *C. horridulum* (from the curled or prickly appearance of its crowded branches), which, like the typical species, I never failed meeting with all around Plymouth, especially during the summer months, in the sheltered bays near Bovisand when the tide was gently flowing in. The rare and curious *C. cruciatum* is found on mud-covered rocks on the southern shores of England and Wales. I took this species in abundance, many years ago, in two or three situations in Plymouth Harbour. The fronds, which are about 3in. high, are divided into a number of long erect branches, which are occasionally furnished with a second and even third series; the ramuli on all being crowded at the tips, giving the plant a remarkably feather-like appearance. The ramuli are usually pinnated or winged, and are set on each joint of the branches in pairs, and sometimes more numerously, but always exactly opposite; an arrangement which (in addition to the division of the tetraspores, which are four-parted or cruciate) is referred to in the specific name of this plant. *C. pumilum*, taken in Miltown Malbay, in Ireland, and once by me up the river Plym, is a small variety of this species; the ramuli are much more closely set on the branches, and the joints of the stems and branches are shorter. *C. floccosum* is a rare early summer annual, found at the Orkneys and on various parts of the Scottish shores. I have had most lovely specimens sent me from Peterhead, some bearing favellæ in abundance, and others full of tetraspores. The fronds of this species are densely tufted, but sparingly and distantly branched. The branching is alternate, but every joint of the stem and branches throws out from each side of the upper shoulder, a pair of opposite, very short and slender, bristle-like ramuli. The tetraspores are borne on each side of these little ramuli, seated on short pedicles or stalks, as seen at *b*, Fig. 195, which represents a magnified portion of stem, branch, and fruited ramulus. The colour is a brownish-red; the whole plant is very flaccid, and adheres very well to paper. A highly magnified fruited branch of *C. Turneri* is represented at *c*, Fig. 195. The fronds of this small species are rarely 2in. high. They grow in little bushy tufts on several species of seaweeds on various parts of the British coasts. The joints of the stems and branches are of much greater length than almost any other species of *Callithamnion*, and the branches are consequently very far apart, but, as well as the ramuli, invariably opposite. The favellæ, which are very similar to those of *Griffithsia setacea* (Fig. 192), are produced on stalks, and are enclosed in an involucre, or clasped by several tiny incurved ramuli. The colour is rose-red, turning a duller tint in drying. *C. barbatum*, so named from the small beard-like ramuli which clothe the upper parts of its long straggling branches, is a plant of such rare occurrence, that during the many years I have searched the shores of this country, I have met with but a solitary specimen. It is said to grow at Weymouth and Penzance, and should be looked for on mud-covered rocks, near low-water mark. The fronds are about 2in. high; the branches, which are opposite, but sometimes

alternate along the stems, are bare for about half their length, and then produce the little, erect, opposite, spine-like ramuli, which are referred to in the specific name of the plant. Tetraspores are seated on the sides of the winglets or terminal branchlets. The brownish-red colour of its fronds sometimes betrays it in its muddy habitat, but it requires experience and sharp eyes to detect it at any time.

C. pluma, a minute species, rarely above half an inch high, grows in little erect velvety tufts on the stems of *Laminaria digitata* (Fig. 46); but is very rarely met with, though it occurs in widely separated situations. It partakes somewhat of the character of the preceding species, in having the upper part of its fronds set on each side, but sometimes on one side only, with short setaceous ramuli. This little plant is rather like small forms of *C. Turneri* (Fig. 195). The colour is a bright red; but the whole plant is so minute, that, except as a curiosity, it is hardly worth the trouble of mounting. Section 2, *Fruticosa*, includes the species which are essentially shrub-like, the main stems being more or less opaque, the basal joints more particularly, being coated within or traversed by numbers of filaments, which in some species render the jointing nearly undistinguishable. The ramuli in all the plants of this group are placed alternately on the branches. *C. arbuscula* is a particularly robust and shrub-like species. The branches are so densely clothed with a second series of shorter branches, all of which are set with numerous closely placed minute pinnated, or winged ramuli, that, unless the whole be considerably pruned or thinned out, it is quite impossible to make anything of a specimen of this bushy plant. The fronds are from three inches to about six inches long, and, in the growing state, are of a very dark blood-red colour. This species is, I believe, perennial. It is not found on any of the southern shores, but is generally met with on the north-western coasts of Scotland and Ireland. I never failed finding it in the deep rock pools of Whiting Bay, in the Isle of Arran; but all the specimens I took there were thrown up from deep water. Even at the lowest spring tides I never found it growing. The tetraspores are produced on the inner side of the ramuli; favellæ are usually bi-lobed. Next to this northern species of *Callithamnion*, the common *C. tetragonum* is perhaps the most bushy and shrub-like of this section. Well-grown plants, such as we have attempted to depict at Fig. 196, are more or less tufted, each frond having a main stem set with lateral branches, which gradually diminish in length as they approach the summit, giving an elegant pyramidal outline to the frond. All the branches are set with a second and third series, and the tufts of ramuli, which are produced abundantly on each side of the branches, are somewhat incurved; the joints are narrow at the base, then gradually widen and become suddenly pointed at the tips. The tetraspores, which are very minute, are produced near the tips of these terminal ramuli. Favellæ of large size, solitary, or bi-lobed; when the latter, the large oval masses are attached to the upper forked ramulus of the terminal branchlets. The colour is a dark brown red, turning an

orange or yellowish in decay. This species is a summer annual, and is found most frequently growing on the stems of the larger algæ near low-water mark. Very nearly related to the plant just described is the beautiful

FIG. 196. *Callithamnion tetragonum.*

species *C. brachiatum* (Fig. 197); indeed, by some writers it is considered merely a variety of *C. tetragonum*. It is, however, a much more delicate plant, especially in the form and finish, so to say, of the branched or tufted ramuli, which in this species are gradually tapered from the base, and

FIG. 197. (*a*) *Callithamnion brachiatum.* (*b*) *Callithamnion Brodiæi.* (*c*) *Callithamnion Hookeri* (highly magnified).

terminate in a sharp point, while in *C. tetragonum* they are narrow at the base, bulged out in the central joints, and suddenly pointed at the tips. Fig. 197, *a*, is a highly-magnified ramulus of *C. brachiatum*,

bearing on the inner face of the terminal angle a large favella. Tetraspores, when present, are similarly situated to those of the foregoing species. I have always found this pretty plant growing on the tips of *Laminaria digitata* (Fig. 46). Many years ago I took a large number of specimens in fruit, all of which were growing on the *Laminariæ* outside the well-known Mewstone Rock near Plymouth; and some years later I found portions of the fronds of *L. digitata* cast ashore one stormy day at Atherton, in the Isle of Wight, every one of which had a fringe of this lovely *Callithamnion*, both kinds of fruit being found in abundance among the numerous specimens I collected on that occasion. The fronds of this species in the barren state are occasionally above 5in. long, but no specimen taken by me, in either kind of fruit, ever excedeed 2in. in length. The colour is generally a rich deep red. *C. Brodiæi* (Fig. 197), although widely distributed in Britain, is certainly by no means abundant in any recorded habitat. I have taken it in fine condition at Plymouth, and occasionally in Torbay. The fronds are rarely over two inches high, densely branched, and set throughout with several series of branchlets, which gradually shorten upwards, and all are furnished with tiny winged plumules, the little spine-like pinnæ which compose them standing out almost at right angles from the joints from which they arise, being what is termed "erecto-patent." In plants which bear favellæ, the branching is much more irregular than in those which produce tetraspores. The favellæ are attached in pairs, one on each side of the stems of the branchlets, as seen at *b*, Fig. 198. The tetraspores are globular in form, and are seated on the inner face of the terminal ramuli, which are thrown out in pretty regularly alternate order on each side of the lesser branches. I have usually found this rare plant on the *Fuci* at extreme low water mark. The colour is a deep brown-red, but loses much of its brilliancy in drying. *C. Hookeri* (Fig. 197), named after the late Sir W. J. Hooker, is also widely distributed in this country, but must be considered among the rarities, as it certainly is one of the favourites of its tribe. It grows on several species of algæ, but I have only found it on submerged rocks, near low-water mark, at Bovisand, near Plymouth. The fronds of this lovely little plant are seldom more than two inches high, and are closely set with rather long branches, which, near the tips, bear a second and even a third set; and on the terminal or central plumules of the lateral branches the pretty pair of oval or lobed favellæ are produced, loosely attached to each side of the joints, as seen at *c*, Fig. 197. Tetraspores are seated on the inner face of the ramuli on the joints nearest to the stem; sometimes they are placed on each side of the ramuli, one or two under, and several above. The colour is usually a brownish-red, or sometimes a rosy-red; young plants generally retaining their beautiful tints in drying. *C. tetricum* (Fig. 198 and 199) is one of the coarsest and most common species of this genus. It is perennial, and is found on all the rocky coasts of Britain, hanging from the under side of ledges of rock, whence

it is easily obtained when the tide recedes, and frequently (growing in society with it) pretty specimens of *Ptilota elegans* (Fig. 187), finely coloured plants of *Delesseria alata* (Figs. 116 and 117), and sometimes *Griffithsia setacea* (Fig. 192), will reward the diligent collector. *C. tetricum* requires some careful manipulation in order to make a good book specimen, for the fronds are densely branched and very bushy. Young plants are most easily managed, or such as do not exceed in size the one represented at Fig. 198, other-

FIG. 198. *Callithamnion tetricum.*

wise the pretty and tolerably regular branching of the lateral plumules cannot be effectively displayed. The magnified branch in our illustration, Fig. 199, with its long plumules and awl-shaped ramuli, which are set alternately on the upper half of the branchlets, was taken from one of the fronds of the plant, which is represented the natural size at Fig. 198. The colour of this species is a dark brown-red; the substance is very rigid, and the fronds do not adhere very firmly to paper. The favellæ are mostly in pairs, and are seated near the tips of the terminal pinnæ or winglets. Tetraspores are attached to the ultimate ramuli. I have always

FIG. 199. *Callithamnion tetricum* (magnified).

FIG. 200. *Callithamnion roseum.*

found this common species most abundantly in Torbay and at Plymouth. Section 3, *Rosea*, contains some of the most lovely plants of this genus. The main stems of all are mostly very slender, and the joints or articulations of the branches are pellucid and very distinct. In some of the older plants of several species in this group the main stems are nearly opaque, being traversed or filled with veins or longitudinal filaments. In all, the ramuli are alternate, never opposite.

C. roseum, represented the natural size at Fig. 200, is found on muddy rocks, and sometimes on other weeds near low-water mark, on the coast of Norfolk, at Brighton, and down the south coast of Devon and Cornwall. At Plymouth I have often found this species in the highest perfection. I have taken specimens there, the fronds of which were over 6in. long, and the colour an exquisite mixture of light purple and brilliant crimson. The fronds of this beautiful species are excessively branched; all the branches are irregularly pinnated or winged, and these pinnæ or winglets are set with wide spreading ramuli, which gradually shorten towards the tips, giving to the pretty plumules a graceful pyramidal outline. These plumules are generally so crowded in the upper branches, that they give a very densely feathery appearance to the outline of the plant, as well as a deep rosy tint to the terminal portions of the fronds. Tetraspores are seated on the inner face of the ramuli, about three or four on the lower ones, and diminishing in number upwards, as seen in the magnified plumule at *a*, Fig. 201. Favellæ are produced near the tips of the plumules. The joints of the stems are about three times, those of the ramuli about twice as long as broad. The plant is an annual, and is in perfection during the summer months. *C. byssoideum*, though met with in many situations, is by no means a common species. The fronds of this plant are extremely slender, and very difficult to display without injury. They are densely branched from the base, and crowded throughout with lesser branches, all of which are clothed with very flaccid byssoid branchlets, set with slender pinnate ramuli, which generally shorten upwards and terminate in a fine point. The joints of the stem and principal branches are about six times longer than broad, and those of the ramuli somewhat less. Tretraspores, elliptical in form, are seated on the inner side of the ramuli, as seen in the magnified plumule at *b*, Fig. 201. Favellæ, which are sometimes three-lobed, are attached to the sides of the stems. This species is occasionally mistaken for fine or delicate forms of *C. corymbosum* (Figs. 203 and 204), but the joints in the branches of the latter are much longer, and the terminal branchlets are more level-topped, each fork being tipped with a pair of divaricating articulations, slightly longer than broad. The colour is a delicate rose-pink, in early growth a rich brown-red, and the plant firmly adheres to paper in drying. *C. polyspermum*, so named from the abundance of its tetraspores, which are produced on the spreading spine-like ramuli of the lesser branches in regular closely set series from the base to the tip, as seen at *c*, Fig. 201. The globular

tufts of this little plant are from 2in. to 3in. long, and are densely branched; the lesser branches being more or less pinnated or branched in a similar manner, the ramuli being subulate or awl-shaped, and of nearly uniform length, but shortened towards the tips of the pinnules, and sometimes curved outwards or reflexed. Favellæ are usually clustered, and are placed about the centre of the stems of the plumules, as represented at *d*, Fig. 201. The colour of this pretty summer annual is a rose or purplish-red. It is met with at Brighton and in Torbay, but in much greater abundance and beauty at Plymouth, where, on muddy rocks at low-water mark, I have often detected its little rosy fronds just appearing on the surface of its uninviting habitat. *C. Borreri*, dedicated to Mr. Borrer, of Brighton, is a beautiful and very distinctly-marked species, all the upper branches being set with distichous plumules (or plumed branchlets set in alternate opposite series), the lower portions being destitute of ramuli, the upper furnished with wide-spreading pinnæ, the lowest of which are longest. These little closely-plumed branches give a beautifully-feathered outline to the plant, and, under the microscope, when this species is in tetrasporic fruit, the ramuli of the little feather-like branchlets seem as though they were bordered with crimson cherries. The favellæ also are a beautiful sight, being seated in pairs on each side of the stem of a plumule; each lobe being contained within a transparent envelope, as represented at *e*, Fig. 201. The colour varies from a pale rose-red to a dull brown-red. The filaments are also of variable length, being from two inches to five inches long. The plant is in perfection in May or June, and is taken in various parts of England and Ireland. My finest specimens were gathered on the muddy banks near Tor Point, and under Mount Edgcumbe in Plymouth Harbour. *C. tripinnatum* is an extremely rare and very exquisite little annual. Under the microscope it has very much the character of the foregoing; but it differs from that, as from all others of its tribe, in having a very minute ramulus, which springs from the first joint in the angle of each plumule. It has been taken on the west coast of Ireland and at Plymouth, but hitherto I have not had the good fortune of meeting with it. *C. affine*, another very rare species, quite unknown to me, except through Dr. Harvey's beautiful figure of it in the "Phycologia Britannica," was found many years ago on the shores of the Isle of Bute. *C. fasciculatum* is also very rare, and, like the foregoing plant, is, to my mind, a very doubtful species. It was found many years ago at Yarmouth by Mr. Borrer. The figure of it in the Phycologia is that of an exceedingly beautiful plant, but any lengthened description here of such very decided rarities seems to me to be utterly unnecessary. *C. gracillimum* (Fig. 202) is probably the most graceful and beautiful of all the British species of this charming tribe of algæ. It was discovered, I believe, by Mrs. Griffiths, on the muddy base of the pier at Torquay. The plant was published originally under its present name, by Professor Agardh; but it is to be regretted that the name *C. filicinum*, proposed for it by its discoverer, was not adopted in the first instance, since the plant is so

Fig. 201. Magnified branchlets of (*a*) *Callithamnion roseum*, (*b*) *C. byssoideum*, (*c*) *C. polyspermum*, with tetraspores; (*d*) the same, with favellæ; (*e*) *C. Borreri*.

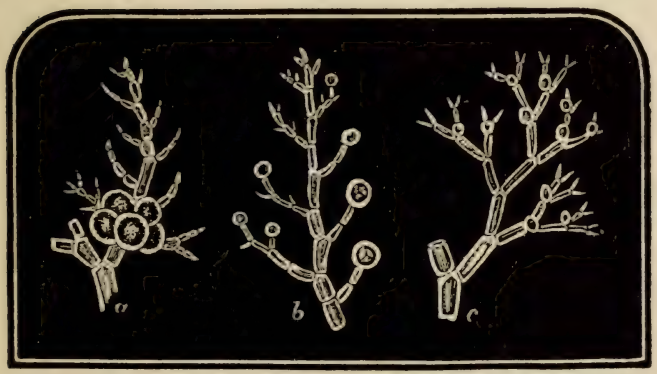


Fig. 202. (*a*) Magnified branchlets of *C. gracillimum*, with favellæ; (*b*) the same, with tetraspores; (*c*) *C. granulatum*.

exactly like one of the most delicately branched exotic ferns in miniature. This lovely species grows abundantly at Plymouth, at Falmouth, and also in its former habitat here in the Torquay harbour. The graceful filaments of this plant are from 2in. to 5in. long. The stems of the branches are very slender, and are set in alternate series along the main stems. All the branches are bi-tripinnate, or furnished with an opposite row of branchlets, from which spring short pointed ramuli, some of which are branched, or bear a second, and sometimes even a third series of lesser ramuli or pinnulæ. No figure could possibly do justice to such minute and delicate branching as we behold in this species ; I must, therefore, be content to refer the reader to *a* and *b*, in Fig. 202, which represent, severally, magnified plumules, showing the form and position of the clustered favellæ and the tetraspores, the latter being a transformation of the terminal joints of shortened pinnules. The colour is a full rose-red, being much paler when the plant produces favellæ, which appear like little dark red spots on the stems and branches. *C. thuyoideum*, like a cypress in miniature, has a strong resemblance to the young state of the foregoing plant. Its densely branched little fronds rarely exceed 2in. in height ; but, except in some minor particulars, the ramification is so similar to that of *C. gracillimum*, that experienced algologists are now and then at a loss to decide between them. The branches are, however, shorter, and the plumules are set closer together, and the joints throughout the plant are proportionately thicker or broader. The tetraspores are produced in exactly the same position as those of the preceding, but the favellæ are very different, being bi-lobed, and thrown out from the under side near the base of the pinnules ; those of *C. gracillimum* being, as described, produced in clusters on the branches or at the junction of two articulations near the base of a branched plumule. This rare little annual has been found in widely-separated situations in England and Ireland. I have taken it in Torbay and at Plymouth ; specimens from the latter place being always of a fine rose red. The substance is very soft and tender, and the plant adheres very well to paper. Section 4, *Corymbosa*, contains only two British species, the stems of which are distinctly articulated, the lower joints of one of these species being, however, traversed by dark-coloured veins ; the ramuli are dichotomous, or branched by more or less numerous forkings. *C. spongiosum*, so called originally from the spongy appearance of its excessively crowded and matted tufts of ultimate ramuli, is now named *C. granulatum*, in reference to its abundant granular or tetrasporic fruit. This curious species is found during the summer on the shady side of submarine rocks at low-water mark. Its densely-branched fronds, which are rarely over 4in. high, bear a striking similarity to those of the northern species, *C. arbuscula ;* and it appears that our *C. granulatum* occupies the place of *C. arbuscula* on shores where the latter is not found, never growing together, in fact, though, as observed by Dr. Harvey, "both affect similar situations on different shores." My own experience concerning these peculiar species perfectly agrees with these remarks of Professor

Harvey. *C. arbuscula* I have taken in Scotland only; *C. granulatum* I have found in Torbay, and at Plymouth frequently, but on no northern shore. The branches of this shrub-like plant are very closely set, but are spread out in all directions; and these throw out a second and third series of lesser branches, all of which terminate in little fan-shaped branched ramuli, the tips of which are forked, the outline being somewhat arched. Tetraspores are produced singly, in or near the base of the forked ramuli; as seen in the magnified branchlet at *c*, Fig. 202, bilobed-favellæ are placed in the angles of the branches. The colour is a purplish red; but all my specimens in drying became a most beautiful sepia, or sometimes Vandyke brown. *C. corymbosum* is one of the rarities, as well as one of the most delicate of this genus; its general appearance is represented at

Fig. 203. *Callithamnion corymbosum.*

Fig. 203. The terminal branchlets are fastigiate or level-topped at the tips, which are of the utmost tenuity, and are crowded together to such an extent, as to appear like numbers of little red corymbs crowning the branches, whence the specific name. The branching of this species is often very irregular, but the great length of the joints in the stem and branches, and the bifid tips of its corymbose terminal branchlets, are characters so distinct that it cannot very easily be mistaken for any other species. The tetraspores are attached to the sides of the joints just below the forkings of the terminal ramuli, as represented at *a*, Fig. 204, and the favellæ, which are bi-lobed and of large size, are produced in the axils of the branchlets, immediately under the little rosy-red corymbs, as seen at *b*, Fig. 204. The substance is so soft and gelatinous that the plant adheres perfectly to paper when drying. A most lovely, and, as it appears

to me, new species of *Callithamnion* has been sent to me from Plymouth, being found pretty abundantly, growing on the *Fuci*, at low-water mark in some part of Plymouth harbour. It was discovered there by Mr. E. M. Holmes, and published by him in the September number of *Grevillea*, accompanied by some beautiful figures, showing its growth, structure, and peculiar system of fructification. Whether it be really a new species or not, I do not pretend to decide, though I believe it to be so. However, as it seems to me to possess some characters which bring it pretty nearly to the corymbose section, I mention it here in order to inform students and collectors what a beautiful plant awaits them on the muddy bank at Torpoint, Plymouth; and doubtless ere long it will be found in others situations in that locality. This interesting plant is somewhat similar to the beautiful *Seirospora Griffithsiana* (Fig. 193); but the fructification is very differently situated, being produced in branched necklace-like cells, which arise in tufts from the rachis of the plumules and pinnæ, just at the junction of two opposite branchlets, some little distance below the tip; but these sporiferous filaments are never produced in the terminal branchlets,

FIG. 204. (*a*) *Callithamnion corymbosum*, with tetraspores; (*b*) the same, with favellæ, magnified.

as is the case in *Seirospora*. There are other remarkable characters observable in this plant, but the brief description given above is sufficient for my present purpose; and ere long I trust the discoverer may be able to publish this plant with a recognised name, and also be in a position to state whether it be really a new species, or merely a variety of some exotic which has found its way to these shores, and so become associated with our marine flora.

Section 5, *Pulvinata*, contains three small species, which consist of densely branched cushion-like tufts, or sometimes like patches of velvet pile, usually found growing on rocks near low-water mark. *C. Rothii* (Fig. 205), dedicated to Herr Roth, is said to be a perennial species, fruiting in winter. About seven years ago I found this tiny *Callithamnion* in very great abundance, growing on the rocky sides of a cave on the coast of Durham, a little below Tynemouth. This cave could only be entered, even at low water, in a boat, and, although (as the boatman informed me) many a smuggled keg of spirits had been concealed there, I doubt if any algologist had ever been there before me. The filaments of this little

plant are rarely an inch high. The branches are very short, slender, and erect, and lie very close to the filaments from which they arise, which is usually near the tips. The joints are about twice as long as broad. Tetraspores are the only form of fruit I have met with on this species. They are produced in clusters of twos and threes, on the tips of terminal branched ramuli, as seen at *a*, Fig. 205. The colour is a deep purplish red. A variety of this plant, called *C. purpureum*, is known by its more minute filaments, which are very sparingly branched. The little velvet-like tufts are found sometimes on marine rocks in long purplish-red masses, scarcely a quarter of an inch high. *C. floridulum* (Fig. 205), which is so common on the west of Ireland that it is carted away from the shore and employed as manure, is found in various situations in this country and in the Orkneys. I have taken lovely specimens of it at Hastings and at Plymouth. The filaments are produced in dense erect tufts about an inch and a half high, slightly branched, and furnished with a very few terminal branchlets or ramuli, which are densely appressed or arranged almost parallel with the branchlets from which they spring. The joints of the stems and branches are nearly all about three times as long as broad. The fruit of this species, which was discovered by Mr. Ralfs, the well-known naturalist, consists of very minute tetraspores, which are borne on tiny little pedicels, usually in a series of three, ranged on the outer side of the terminal branches. A fruited filament is represented at *b*, Fig. 205. The colour is a pretty mixture of crimson and purple, and when plants in good condition are carefully mounted on paper they make very attractive book specimens; as in drying, the filaments have the soft texture and glistening appearance of tufts of floss silk. *C. mesocarpum* (Fig. 205), so named from the situation of the tetrasporic fruit, which is produced on single or forked pedicels about the middle of the little erect filaments, is a very minute and a very rare species, found originally at Appin, in Scotland, by the late Captain Carmichael, and once only by myself in Lamlash Bay. Portion of a filament bearing tetraspores is represented at *c*, Fig. 205. The joints of the tiny fronds of this plant are about four times as long as broad. The colour is a brownish red or purple, and, to the unassisted eye, the whole plant appears like a mere dark reddish crust attached to the rock on which it grows. The last section of this lovely group of seaweeds contains two or three species, which are minute parasites, and, like several of the foregoing, are hardly distinguishable as vegetable structures, unless they are examined under a tolerably powerful microscope. However, as each species is pretty constant to some particular plant, which the student will easily recognise, a very slight examination of the decaying fronds of those I am about to name, will doubtless reward the collector for his search after these microscopic *Callithamniæ*. It has often been said that the roots of the great *Laminariæ*, which are thrown ashore after a storm, are a mine of wealth to the zoologist; and certainly, if properly examined, old fronds and stems of the same species are frequently rich in micro-

scopic parasites, which, particularly on account of their rarity, are the delight of all enthusiastic algologists. Among these minute parasitic plants, may occasionally be found, in tiny scattered tufts, less than a quarter of an inch high, the rare and curious species, *C. sparsum*, the filaments of which are nearly straight, with blunt tips, and very sparingly branched, rarely more than a single branch or ramulus being thrown out from one side of the erect filaments near the terminal portions. The colour of this plant is a pinky-red. Its most frequent place of growth is on the stem or decaying frond of *Laminaria saccharina* (Fig. 43.) *C. Daviesii* is most generaliy parasitic on the decaying fronds of *Ceramium rubrum* (Fig. 176) in rock pools about half-tide level. I once dredged in Plymouth Sound a very fine plant of *Sporochnus pedunculatus* (Fig. 55), every branch of which was infested throughout with most luxuriant specimens of this lovely little *Callithamnion*, beautifully in fruit. The little tufts of this plant are about a quarter of an inch

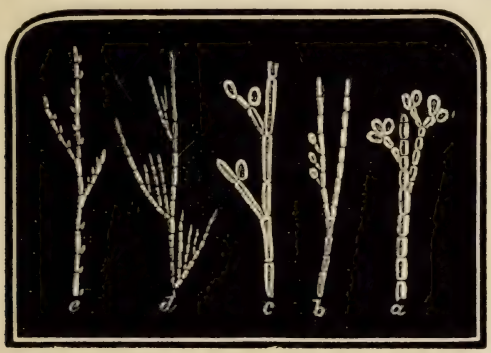


FIG. 205. Magnified filaments—(*a*) *Callithamnion Rothii*; (*b*) *C. floridulum*; (*c*) *C. mesocarpum*; (*d*) *C. Daviesii*; (*e*) *C. virgatulum*.

high, the branches are alternate, and at intervals of four or five joints apart, a short branch is thrown out, which bears on its inner face a series of small erect ramuli, the longest of which is nearest the axil, so that the three are nearly on a level at the tips. Tetraspores, when present, are attached to these axillary ramuli. Part of a terminal branch is represented at *d*, Fig. 205. *C. virgatulum*, or the twig-like callithamnion, is considered by some writers to be merely a variety of the preceding species. It is also parasitic on *Ceramium rubrum*. The little lateral branches are produced much in the same way as those of the foregoing, but the ramuli are so short that they appear to consist merely of a single cell arising from one side only of the stems and branches. A branch of this plant is represented at *e*, Fig. 205. The tufts of this little parasite are about a quarter of an inch long, of a pinky-red colour, and they sometimes so completely envelope the fronds of the plant of

which they grow, that nothing but the parasite itself is visible to the unassisted eye. I have met with this species in Scotland, and on various parts of the southern shores of England, but most abundantly and beautifully fruited, in Torbay and at Plymouth.

I have now concluded my description of the British marine algæ, in which I have endeavoured to fulfil the promise of my introduction to this work, viz., to supply any of my readers who may visit the seashore, with a subject to occupy their leisure, to interest them in the vegetable productions of the deep, and to instruct them in preserving such specimens as they may collect for future study. With the exception of a few very rare plants and some minute parasites, every species of seaweed which is likely to be met with on the shores of the British islands has been accurately figured, either from the living plant, or from photographs or drawings of magnified portions; so that, with these illustrations before them, and the help of even an ordinary lens, I make bold to say that few collectors will find any particular difficulty in identifying such plants as they may meet with during their rambles on the seashore.

ADDENDA.

In describing the *Ulvæ* at pages 8 and 9, I unintentionally omitted the species *Ulva lactuca*, so called from its fancied resemblance to a cos-lettuce. In early growth this plant is a long pear-shaped bag, which bursts at the top and splits down the sides, spreading out into segments of irregular shape and size. In structure this species differs from others of the genus, on which account, as observed by the late Mrs. Gatty, a subdivision of the *Ulvæ* was proposed, under the name of "*Phycoceris*," to include *Ulva latissima* and *U. linza*. I prefer, however, to retain these plants in *Ulva*. The membranous fronds of these two species are double, though adhering closely together, while those of *U. lactuca* are composed of a single layer of cells. The mature frond of this plant is about 6in. long, and its colour is usually a pale green. Its place of growth is on rocks, shells, and also on other seaweeds, between tide-marks.

The interesting species *Polysiphonia divergens* has been added to our British Marine Flora by Mrs. Merrifield, of Brighton, who identified it as such in a plant which was taken at Falmouth in 1861. It is a native of the South Atlantic, and is found at Cadiz, and also in the Adriatic. The plant is of small size, the fronds are very slender and much entangled; in general aspect this rare species bears some resemblance to *P. spinulosa*. The siphons of the stem are six or seven, and are of nearly equal diameter.

Fucus anceps is another rarity, which is taken, I believe, only on the west coast of Ireland. It was discovered by Harvey and Ward, and published as a new species by Mr. S. O. Gray in his "British Seaweeds." I have not seen this species in the growing state, but the dried specimen which I possess, very strongly resembles the barren form of *Fucus canaliculatus* (Fig. 34), except that the fronds are not channelled and the terminal forks are not quite so blunt at the tips.

Fig. 47 in this work, is an accurate representation of a young plant of *Laminaria stenophylla*, which Dr. Harvey has described as a var. of *L. digitata* (Fig. 46), but which is now regarded by Professor Agardh as a distinct species, and I think justly so. The chief points in which they differ are as follows. The stem in *L. digitata* is always round and roughish to the touch, especially in mature plants, when the periphery, or outer margin, may pro-

perly be termed the bark of the stem ; but in *L. stenophylla* the stem is compressed or flattened, and is smooth at all stages of its growth, and entirely destitute of bark. In *L. digitata*, when the tide leaves the growing plants exposed, the stems stand up out of the water like hard curved sticks, but those of *L. stenophylla* are soft and pliable, and when the tide recedes entirely from them, the stems and long leathery fronds lie limp and flat upon the rocks where they grow. Again, as regards the manner in which the fronds of these species are digitated or cleft, there is a very marked difference. In *L. digitata* the laciniations commence very nearly at the base of the lamina, just where it expands above the stem ; and frequently as many as a dozen or more radiate from this point, often reaching a length of several feet without further division in any of them ; but in *L. stenophylla*, the divisions are much less numerous, of far greater proportional length, and the secondary laciniations are more regular and also few in number, and very narrow as they approach the tips. The situations in which these plants grow are also very different, for, although *L. digitata* is found in pools often above half-tide level, its ordinary place of growth is below tide-marks and extending into deep water, while *L. stenophylla* vegetates within ordinary tides, and may be said to form a zone, as it were, between the larger *Laminariæ* and the shore.

To the Orkney kelp-gatherers, the differences between these two species are so marked, that peculiar local names are assigned to them, *L. digitata* being known as "Cuvy," while *L. stenophylla* is always called "Tangle."

In the north of Scotland a gigantic form of *L. saccharina* (Fig. 43) is met with, which, I am informed, Professor Agardh considers identical with *L. caperata*, a large species which is a native of Spitzbergen. The frond of this plant is nearly 2ft. wide, and very much curled and fringed at the margins. In conclusion, I may briefly refer to the large species, *L. bulbosa* (Fig. 48), which will henceforth be known as *Sacchorhiza bulbosa*, the bulbous or bag-rooted laminaria ; a change of name which I consider highly appropriate, the large bulb or bag-like root of this curious species being fully as characteristic as the common name of "sea-furbelows" is of the puckered or waved margins of its flattened stem.

A COMPLETE

LIST OF BRITISH SEAWEEDS,

Containing all the most recent changes of the names of the plants as they occur in the works of Dr. Harvey, Professor Agardh, and Dr. J. E. Gray. (The old names are in italics.)

CHLOROSPERMEÆ.

Order Bulbochetaceæ.
Ochlochæte hystrix.

Order Confervaceæ
Cladophora albida
arcta
Balliana
Brownii
diffusa
falcata
flavescens
flexuosa
fracta
Gattyæ
glaucescens
gracilis
Hutchinsiæ
lanosa
lætevirens
Magdalenæ
Macallana
nuda
rectangularis
refracta
repens
Rudolphiana
rupestris
uncialis.
Chætomorpha ærea
arenicola
arenosa
implexa
linum
melagonium
sutoria
tortuosa
Cytophora litorea.
Hormotrichum bangioides
collabens
Cutleriæ.
Younganum
(The thirteen foregoing plants were formerly included in the genus Conferva.)

Carmichælianum (*Lyngbya Carmichælii*)
speciosum (*Lyngbya speciosa*).
Leptocytea pellucida (*Cladophora pellucida*).
Rhizoclonium riparium
Casparyi
flaccum (*Lyngbya flacca*)

Order Nostochineæ.
Monormia intricata.
Spermosira litorea
Harveyana.
Sphærozyga Carmichaelii
Berkeleyana.
Broomei.
Thwaitseii.

Order Oscillatoriaceæ
Actinothrix Stokesiana
Arthronema cæspitula (*Calothrix cæspitula*).
hypnoides (*Calothrix hypnoides*).
Calothrix confervicola
luteola
pannosa
scopulorum
semiplena.
Lyngbya ferruginea
majuscula.
Microcoleus anguiformis
Oscillatoria insignis
littoralis
nigro-viridis
spiralis
subsalsa
subuliformis
Rivularia atra
nitida
plicata.
Schizosiphon Warreniæ.
Schizothrix Creswelli.
Spirulina tenuissima.
Tolypothrix fasciculata (*Calothrix fasciculata*).

Order Siphonaceæ
Codium adhærens.
amphibium
bursa
tomentosum.
Vaucheria clavata
marina
submarina
velutina.
Bryopsis hypnoides
plumosa.

Order Ulvaceæ
Porphyra laciniata
linearis
vulgaris.
Ulva lactuca
latissima
linza.
Enteromorpha clathrata
compressa
cornucopiæ
erecta*
Hopkirkii*
intestinalis
Linkiana*
percursa*
Ralfsii*
ramulosa.*
(Those marked * are merely varieties of Enteromorpha clathrata.)
Bangia carnea
ciliaris
elegans
fusca-purpurea.
Goniotrichum ceramicolum (*Bangia ceramicola*).

MELANOSPERMEÆ.

Order CHORDARIACEÆ
- Chordaria flagelliformis
  - divaricata.
- Elachista fucicola
  - attenuata (*E. pulvinata*)
  - curta
  - flaccida
  - Grevillei
  - scutulata
  - stellul ta
  - velutina.
- Myrionema clavatum
  - Leclancherii
  - punctiforme
  - strangulans.
- Leathesia Berkeleyi
  - crispa
  - tuberiformis.
- Mesogloia Griffithsiana
  - vermicularis
  - virescens.
- Ralfsia deusta
  - verrucosa.

Order DICTYOTACEÆ
- Asperococcus compressus
  - echinatus.
  - Turneri.
  - vermicularis.
- Cutleria multifida.
- Dictyota dichotoma.
- Dictyota var. intricata.
- Dictyosiphon fœniculaceus.
- Haliseris polypodioides
- Litosiphon pusillus (*Chlorosiphon pusillus.*)
  - laminariæ.
- Padina pavonia.
- Punctaria latifolia
  - plantaginea
  - tenuissima.
- Stilophora rhizodes
  - Lyngbyæi
- Striaria attenuata.
- Taonia atomaria (*Dictyota atomaria.*)
- Zonaria collaris
  - parvula.

Order ECTOCARPACEÆ
- Cladostephus spongiosus
  - verticillatus.
- Chætomorpha plumosa (*Sphacelaria plumosa*)
- Ectocarpus amphibius
  - brachiatus
  - crinitus
  - distortus
  - fasciculatus
  - fenestratus
  - granulosus
  - Hincksiæ
  - Landsburgii
  - littoralis
  - longifructus
  - Mertensii.
  - pusillus.
  - siliculosus
  - sphærophorus
  - tessellatus
  - tomentosus
- Myriotrichia clavæformis
  - filiformis.
- Sphacelaria cirrhosa
  - filicina
  - fusca
  - racemosa
  - radicans
  - scoparia

Order FUCACEÆ
- Cystoseira barbata
  - ericoides
  - fibrosa
  - fœniculacea
  - granulata
- Fucodium canaliculatum (*Fucus canaliculatus*).
  - nodosum (*Fucus nodosus*).
  - tuberculatum (*Pycnophycus tuberculatus*).
- Fucus anceps
  - ceranoides
  - Mackaii
  - serratus
  - vesiculosus.
- Halidrys siliquosa.
- Himanthalia lorea.
- Sargassum vulgare
  - bacciferum

Order LAMINARIACEÆ
- Alaria esculenta.
- Chorda filum.
  - lomentaria
- Laminaria digitata
  - fascia
  - fascia, var. debilis.
  - phyllitis
  - saccharina
  - stenophylla.
- Sacchorhiza bulbosa (*L. bulbosa*)

Order SPOROCHNACEÆ
- Arthrocladia villosa.
- Carpomitra Cabreræ.
- Desmarestia ligulata
  - pinnatinervia
  - aculeata
  - viridis
- Sporochnus pedunculatus.

RHODOSPERMEÆ.

Order CERAMIACEÆ
- Callithamnion affine
  - arbuscula
  - barbatum
  - Borreri
  - brachiatum
  - Brodiæi
  - byssoideum
  - corymbosum
  - cruciatum
  - Daviesii
  - fasciculatum
  - floccosum
  - floridulum
  - gracillimum
  - granulatum (*C. spongiosum*)
  - Hookeri
  - hormocarpum
  - interruptum
  - mesocarpum
  - pluma
  - plumula
    - var. horridulum
  - polyspermum
  - roseum
  - Rothii
  - secundatum
  - sparsum
  - tetragonum

tetricum
thuyoideum
tripinnatum
Turneri
versicolor
virgatulum.
Ceramium acanthonotum
ciliatum
Deslongchampsii
diaphanum
echionotum
fastigiatum
flabelligerum
gracillimum
microcladia Cocksii
rubrum
var. decurrens
var. proliferum (*Ceramium botryocarpum*)
strictum
tenuissimum (*C. nodosum*).
Corynospora pedicellata (*Callithamnion pedicellatum*).
Crouania attenuata.
Dudresnaia coccinea.
Griffithsia barbata
corallina
Devoniensis
secundiflora.
setacea.
Halurus equisetifolius (*Griffithsia equisetifolia*)
var. simplicifilum.
Microcladia glandulosa.
Ptilota plumosa
elegans (*P. sericea*).
Seirospora Griffithsiana

Order Chondrieæ
Polyides lumbricalis (*P. rotundus*).
Lomentaria articulata
kaliformis
ovalis
parvula
reflexa.
(The five foregoing were formerly included in Chylocladia.)
Laurencia pinnatifida
hybrida (*L. cæspitosa.*)
obtusa.

Order Corallinaceæ
Corallina elongata
officinalis
squamata.
Jania corniculata
rubens.
Melobesia agariciformis
calcarea
farinosa
fasciculata
lichenoides
membranacea
polymorpha
pustulata
verrucata.

Order Cryptonemiaceæ
Ahnfeldtia plicata (*Gymnogongrus plicatus*).
Callophyllis laciniata (*Rhodymenia laciniata*).
Catenella opuntia.
Chondrus crispus.
Chylocladia clavellosa (*Chrysymenia clavellosa*)
rosea (*Chrysymenia rosea*).
Cystoclonium purpurascens (*Hypnæa purpurascens*).
Dumontia filiformis.
Furcellaria fastigiata.
Gigartina acicularis
mamillosa
pistillata
Teedi.
Gloiosiphonia capillaris.
Grateloupia filicina.
Gymnogongrus Griffithsiæ
Norvegicus (*Chondrus Norvegicus*).
Halymenia ligulata
var. dichotoma
var. latifolia
var. ramentacea.
Kallymenia microphylla
reniformis.
Phyllophora Brodiæi
var. simplex
membranifolia
palmettoides
rubens.
Schizymenia Dubyi (*Kallymenia Dubyi*).
edulis (*Iridæa edulis*).
Stenogramma interrupta

Order Gelidiaceæ
Gelidium corneum
var. abnorme
var. aculeatum
var. capillaceum
var. clavatum
var. claviferum
var. confertum
var. crinale
var. flexuosum
var latifolium
var. pinnatum
var. pulchellum
var. sesquipedale
var. uniforme

Order Helminthocladiæ
Helminthora divaricata (*Dudresnaia divaricata*).
purpurea (*Nemaleon purpureum*).
Nemaleon multifidum.
Scinaia furcellata (*Ginannia furcellata*).

Order Rhodomelaceæ
Bonnemaisonia asparagoides.
Bostrichia scorpioides.
Chondriopsis dasyphylla (*Laurencia dasyphylla*)
tenuissima (*Laurencia tenuissima*).
Dasya arbuscula
Cattlowiæ
coccinea
corymbifera (*D. venusta*)
ocellata
punicea.
Odonthalia dentata.
Polysiphonia affinis
Agardhiana
atro-rubescens
Brodiæi
byssoides
Carmichaeliana
divergens
elongella
fastigiata
fibrata
fibrillosa
fœtidissima
formosa
furcellata
Grevillii
Griffithsiana
nigrescens
obscura
parasitica
Richardsoni
sertularioides (*P. pulvinata*)
simulans
spinulosa
stricta
subulifera
urceolata
variegata
violacea.
Rhodomela lycopodioides
subfusca.
Rytiphlæa pinastroides
complanata
fruticulosa
thuyoides.
(The three foregoing are now included in the genus Polysiphonia.)

Order Rhodymeniaceæ
Cordylecladia erecta (*Gracilaria erecta*).
Euthora cristata (*Rhodymenia cristata*).
Maugeria sanguinea (*Delesseria sanguinea*).
Plocamium coccineum.
Rhodymenia palmata
var. marginifera

var. sarniensis
var. simplex
var. sobolifera
palmetta
var nicæensis
Rhodophyllis appendiculata.
bifida (*Rhodymenia bifida*).

Order Sphærococcoideæ
Calliblepharis ciliata (*Rhodymenia ciliata*)
jubata (*Rhodymenia jubata*).
Delesseria alata
angustissima
hypoglossum
ruscifolia
sinuosa.
Gracilaria confervoides
compressa
multipartita.
Nitophyllum Bonnemaisoni
Gmelini
Hilliæ
laceratum
punctatum
var. crispatum
var. fimbriatum
var. ocellatum
var. Pollexfenii
thysanorhizans
uncinatum
versicolor
Sphærococcus coronopifolius.

Order Spyridiaceæ
Spyridia filamentosa

Order Squamariæ
Actinococcus Hennedyi.
Cruoria adhærens
pellita.
Hapalidium phyllactidium (*Lithocystis Allmanni*).
Hildenbrandtia rubra.
Petrocelis cruenta.
Peyssonelia Dubyi.

Order Wrangeliaceæ
Atractophora hypnoides.
Naccaria Wiggii.
Wrangelia multifida
var. pilifera.

ERRATA.

Page
5, Fig. 3, *for* coloured, *read* colourless.
9, line 36. The word "Order" here, as in all other instances in this work where reference is made to groups of plants, should be printed with a capital letter.
13, line 37, *for* variations, *read* varieties.
17, line 17, *for* Cladophora, *read* Cladophoræ.
35, line 45, omit the word "represented."
38, line 6, *for* mammillæ, *read* mamillæ.
54, line 27, *for* Haliseris, *read* polypodioides.
64, last line, *for* its, *read* of.
72, line 41, *for* lattissima, *read* latissima.
73, line 19, *for* Ectocarpaceæ, *read* Ectocarpeæ.
79, Fig. 80, *for* Ectocarpaceæ, *read* Ectocarpeæ.
98, line 24, *for* strams, *read* streams.
116, lines 1 and 2, *for* Griffithsianes, *read* Griffithsiana; *for* subulata, *read* subulifera; *for* Polyida, *read* Polyides.
141, Fig. 130, *for* latifolia, *read* latifolium.
179, line 25, insert the word "like" between the words "appearing little."
192, line 29, *for* the under, *read* under the.
225, line 11, *for* others, *read* other.
226, line 42, *for* Callithamniaæ, *read* Callithamniæ.

INDEX.

N.B.—In the foregoing index we have mentioned every page in which each plant is referred to, however incidentally, hoping that a searcher may thereby readily trace out the history or peculiarities of any plant about which he desires to know.

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